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Garbage Disposal.

The question of the disposal of the garbage of a great city like New York is a very serious one, and is apparently far from being answered. There was a time when the stuff was dumped in the sea and littered all the bathing beaches in a most disgusting manner. Relief from this was promised a couple of years ago when a municipal plant was started to consume some of this garbage and thereby light Williamsburg Bridge electrically at a cost of less than nothing, instead of paying good money to the lighting companies. Nobody had any particular objection to raise to this and the incinerator plant went into action with a great flourish of trumpets, particularly on the part of the yellow, socialistic press that wants everything municipalized.

Last week we gave the results and details. The plant has proved an absolute failure, and a large part of its machinery is garbage itself, fit only for the dump and scrap heap. This apparatus cost, with the building, about $170,000. Of course the land cost nothing, as it belonged to the city—and, ergo, had no value. While running, the plant cost to operate, without allowance for rental, $31,418. The allowance for depreciation was 5 per cent, but as much of the plant is wrecked, 50 per cent would evidently have been near the mark. To operate with coal, the plant would cost $57,000 a year. The New York Edison has taken the supply over and is giving a much better service for $25,000. Now there is some talk of a larger plant, as the old one burned only one-eighth of the rubbish gathered—but, after all, would it not be well to let bad enough alone?

Milwaukee, which has just been talking about a municipal lighting plant, has had a similar experience with its garbage plant, that ought to be another lesson—but won't be. The city built the plant two years ago when it cost twice the estimates. It was then found that twice as many men as estimated would be required to run it. Now it is found that the plant is falling to pieces, and that while it costs the city $1.89 per ton to dispose of the garbage itself, private contractors have been eager to get the work at 85 cents a ton. "The works have been a municipal scandal for some time, and it has now been decided to abandon them." That has a familiar sound.

Illumination Photometers.

Mr. Preston S. Millar's paper on this topic is valuable in bringing sharply to attention the need of extreme care in illumination measurements and the very common failure of illumination photometers to give reliable results. It is certainly true that an instrument must be a good photometer before it is a good illumination photometer, if the two functions are expected in combination. But it by no means follows that the best form of ordinary photometer is the best instrument for measuring illumination. For this purpose an instrument must be rea-

sonably sensitive and furnished with a reliable comparison lamp if one is used, but the nature of the surface observed and its relation to the sources of light is of far more importance than any other one consideration. The fact is that no known diffusing surface, opaque or translucent, obeys Lambert's law for all planes and angles of incidence. In any event, the chief difficulty is the failure of any surface to integrate correctly according to Lambert's law, the total incident light. For extreme precision, the errors must be known and allowed for either instrumentally or in computation.

After all, there is still some doubt whether, if a correct integration could be had, it would really measure correctly the useful effect. As light is practically employed, it is not received on theoretically exact diffusing surfaces, nor does one customarily work with his head and shoulders below the plane of illumination. For example, take a large and rather low room. If lighted from the ceiling, lamps with reflectors, i. e., with main flux from above and coming in the main from a few lamps for any one point, one does not have to deal with large angles of incidence and the illumination at any one point is not difficult to determine. If the lighting were from a row of lamps around the wall, there would be a large proportion of light at very oblique incidence and in practice one would get his working illumination at any one point from but a portion of the sources theoretically available. Such a room would be a difficult subject for theoretical illuminometry, and the theoretical figure, if obtained, would be deceptively large. The fact is that the useful illumination involves factors which are not proportional to the light flux as integrated at any point. Bearing this in mind, one comes to a realizing sense of the difficulties of illumination measurement. As Mr. Millar has pointed out clearly enough, it is no task for a tyro even with a good instrument, certainly not with a poor one. The next few years will be prolific in careless and inaccurate work in illuminometry. It is the man behind the photometer that counts. Good judgment and a knowledge of the errors will lead to good results even with indifferent apparatus, while it seems very doubtful whether any kind of photometer can be made fool-proof. Results obtained with any of the instruments now available should be received somewhat cautiously, especially where any color differences are involved, and the attempted elimination of color difference is likely to lead to constant errors of serious magnitude. One of the most urgent needs in modern photometry is if not a precise, at least a conventional method of dealing with color differences.

Circular Current Loci of the Synchronous Motor.

On page 309 of our issue for last week, we commented at some length upon the paper by Prof. Morgan Brooks, dealing with the graphical representation of the performance of synchronous motors and generators, an abstract of which was published in our report of the Niagara convention of the A. I. E. E. Our present issue contains an article by Dr. A. S. McAllister describing certain simple loci of the synchronous motor which, while similar to those of Prof. Brooks in that they are circular in form, differ therefrom in that they deal with the measurable current taken by the motor rather than with the internal counter e. m. f. of the machine. It is interesting to note that the current locus for a certain constant excitation of the motor—that is, under normal operating conditions—is similar to the circle diagram of the induction motor. A comparison of the current locus of the induction motor with that of the synchronous motor will show that the lagging wattless component of the current taken by the induction motor has a positive value at any load whatsoever, and that it increases continuously with increase of load; while the wattless component of the current taken by the synchronous motor decreases as the load is first increased from its minimum value, and it may have either a positive or a negative value; that is, it may become leading if the excitation is above a certain percentage for each load.

As in the case of the circular current locus of the polyphase induction motor or that of the single-phase induction motor, the construction is based on the assumption of constant local impedance of the circuits carrying the load current. It is well known that in no case is the reactive component of the impedance constant. In the polyphase induction motor the change in the impedance from its assumed constant value leads to an error that is quite small in comparison with the error due to ignoring the change in the main magnetizing current taken by the motor. In the single-phase induction motor the neglect of the actual change in the circuit impedance produces an error that is negligible in comparison with the large error when both the "speed field" exciting current and the "transformer field" exciting current are considered to be constant, since, as a matter of fact, the latter actually varies about 50 per cent and the former 100 per cent. In the synchronous motor the "synchronous reactance" is far from being constant, and any treatment based on the initial assumption of constant "synchronous impedance" is liable to indicate results which do not accord with facts. It is customary in mathematical treatments to assume a constant value for the synchronous impedance, and it is equally as permissible to assume the same constant value in a graphical treatment. The advantage of the graphical method over the purely mathematical resides in the fact that with the former method results may be obtained quickly, and the student-reader is forced to keep constantly in mind the phenomena involved; while in transposing mathematical equations he frequently loses sight of the physical facts in a maze of symbols which to him may be almost meaningless.

An Anachronistic Experiment.

We learn with interest that a surface-contact electric railway system is to be given a trial in London on a line between Adgate and Bow, and recently there has been an attempt to float the stock of a highly-capitalized surface-contact system in Austria. It is a long time since we have heard much about surface contact and its reappearance at this juncture comes with something like the same shock that would accompany the announcement of a street railway changing from electricity to cable traction. The surface-contact has appeared in many forms, some of them highly ingenious, but it never seemed to have filled any long-felt want. Little has been heard of it in this country since Edison announced his famous low-voltage contact system, which some wag immediately proposed to improve by reducing the working voltage below that necessary for the electrolysis of water, thereby solving once for all the insulation difficulty. Abroad there has been a better field, since foreign municipal authorities have at times had a very absurd amount of prejudice against the overhead trolley, and

have been willing to go to great lengths in trying to avoid it. The fact is that an overhead trolley system properly installed for city service, with all the feed wires underground and the trolley wire carried on suitable iron poles not too closely spaced, is practically less objectionable in many cases than even a slotted conduit, and is certainly more reliable. The conduit road should be confined to lines in very crowded streets with extremely dense traffic.

The surface-contact system is, to apply the old piscatorial saw, "Neither fish, flesh, nor good red herring." It is considerably more expensive and less reliable than a trolley system, and has complications that make the slotted conduit system look like a haven of rest. It is not always easy to say just why a given surface-contact scheme will come to grief, for if one could accurately make prognosis of its failings there would be a fighting chance of finding a remedy. Yet no such system has done more than to demonstrate that it can be kept in operative condition most of the time by a sufficient amount of hand work. A surface-contact line necessarily has a very elaborate series of automatic switches to keep the exposed parts "dead" except when in actual use, and most experienced engineers have learned that automatic devices need watching to an extent that belies their name. First, an automatic device, then another to show that the first has worked, then a tell-tale to indicate whether the second has told the truth about the first, and finally an attendant with an auxiliary normal device to keep the three in order and turn the trick himself if necessary. We do not see the good to be gained by a surface-contact line when the more dependable overhead system can be installed for a much smaller figure. It is an interesting experiment to see tried at some other fellow's expense, so we do not repine at the action of the London authorities. And if the line can be kept in operation at reasonable expense it will do their assiduity infinite credit. Seriously, even if it shall make a passable success, what great gain will be made? It is bad enough to have a car equipped for both trolley and conduit service; it would certainly be no better if it had to be fitted for contact working in an intermediate zone. But it will give some interesting experience.

FLUX OF LIGHT.

One of the proposals at the recent Illuminating Engineering Society convention that is likely to have its influence on future methods of handling illuminating engineering problems is the proposition advanced by Dr. Clayton H. Sharp in his presidential address that we should change our present common conceptions of light so as to consider the flux or flow of luminous energy from a source of light rather than the candle-power. Up to the present time it has been customary for the illuminating engineer to deal with such units as candle-power and foot-candles, taking the candle-power of the source at the angle under consideration and calculating from that the foot-candles of illumination falling on a surface; repeating this process for various points. Likewise in considering the total amount of light emitted from a source, it has been customary to take the mean spherical candle-power. In other words, we are generally in the habit at the present time of considering intensities of light at different points around a source rather than the flux or flow of luminous energy from that source. In short, Dr. Sharp maintains that our present conceptions are unduly complicated and that when we begin to think of light as a flow of luminous energy it will simplify matters. Undoubtedly it will. The conception is especially helpful when considering the total amount of light obtained from a large number of lamps in a large room. Thus, instead of going through the most laborious process of calculating the amount of light received on various points of the working plane from a large number of sources, we would simply add up the flux of light delivered by the lamps and reflectors in the direction of the working plane, and this divided by the area would give the average intensity of illumination over that plane. To carry out this method exactly, to the extent of determining just what lumens fall on the working plane from each lamp, is somewhat complicated, but a practical approximation in large rooms is easy.

The system of units and terms suggested is simple. If the candle-power be taken as the unit of light and the foot as the unit of length, the total flux of light from a lamp in lumens would equal the mean spherical candle-power multiplied by 12.57, the latter figure being the number of unit solid angles in a sphere, and the unit flux of light being that in one unit solid angle. A lumen of light flux would be further defined as the amount of light falling on a plane surface one foot square a foot distant from a lamp of one candle-power. The average foot-candle intensity of illumination falling on a plane multiplied by its square feet area would equal the number of lumens flowing towards the plane. Conversely, the number of lumens directed by lamps and reflectors toward the floor divided by the square feet floor area will give the average foot-candle intensity. Instead of that clumsy, but useful standard of comparison, foot-candles per watt per square foot, we would substitute its numerical equivalent, lumens per watt.

Now as to the practical working of this system in engineering calculations, we have already said the conception of flux of light rather than intensity at numerous points is likely to be helpful. As to just how much saving in engineering calculation may be made it is yet too early to predict. If the engineer is to be in a position to figure rapidly the lumens falling on a given plane in any room from pendant lamps, he must have not only the photometric measurements at various angles of the lamp to be used, but the number of lumens flowing in the direction of the given plant. This can be determined from the Rousseau diagram of the lamp more quickly than can the mean zonular candle-power which we are sometimes in the habit of considering. The total lumens directed towards the working plane by all the lamps in a room is then simply a matter of addition. This, when used in a rough, practical way, is unquestionably easier than the usual calculations using the illumination curve of each lamp, and in many cases will answer all practical purposes when used with judgment. It readily gives the total or average results. It will not, however, give the maximum and minimum value of illumination, which is often of importance to know if the engineer is not previously familiar with the degree of uniformity of illumination that is obtainable with the proposed installation. It is a short cut that can be used like many other engineering short cuts when the user fully undestands its limitations.

Montreal Meetings and Exhibition.

The Canadian Electrical Association will hold its annual meeting in Montreal Sept. 11, 12 and 13. Headquarters will be at the Windsor Hotel, but the meetings will take place in the rooms of the Canadian Society of Civil Engineers, which has offered the use of the rooms to the association. The lecture hall is provided with curtains for darkening the room in the day time, so that the lantern can be used. The society owns a very fine lantern. The Candian Electrical Association have prepared a good list of papers, also a "Question Box." A very large attendance is anticipated. The entertainment committee has arranged a very fine program for the members.

The fall meeting of the Montreal Jockey Club takes place during the first two weeks in September, so that between the races and the program outlined by the entertainment committee, the electrical show and the convention doings, it looks as though the members of the association would have to "work" overtime.

The electrical show will be very complete and will include the wireless telegraph, an electric fountain, dancing skeletons, etc., etc. The Electrical Exhibition Company is furnishing the railings for the entire show, which will be uniform, of a neat design and perhaps the first of its kind on so large a scale.

The Canadian Street Railway Association will also hold its meeting in Montreal, Sept. 12 and 13. The headquarters will be at the Windsor Hotel, and the following is the list of officers of the association: President, Edw. A. Evans, general manager and chief engineer of the Quebec Railway, Light & Power Company, Quebec; vice-president, J. E. Hutcheson, superintendent and purchasing agent, Ottawa Electric Railway Company, Ottawa, Ont.; secretary-treasurer, Acton Burrows, managing director the *Railway and Marine World*, Toronto, Ont. Executive committee, D. McDonald, manager Montreal Street Railway Company; C. B. King, manager London Street Railway Company; A. M. Grantham, superintendent of construction and purchasing agent, Toronto Railway Company and Toronto & York Radial Railway Company.

German Wireless Telegraph Development.

The German official system of wireless telegraphy, the Slaby-Arco method, includes, it is stated, 20 stations in the United States. From Chemnitz, Germany, U. S. Consul Thomas H. Norton reports as follows regarding the system:

"The number of stations equipped with apparatus of this system is now 641, or 41 per cent of the entire list of existing wireless telegraphic stations, numbering 1550. These have all been installed by one Berlin company, which controls a variety of patents in the leading countries on machines and accessories. These 641 stations are scattered over the territory or vessels of 31 different countries. Of these some 174 are located on land. They usually command a radius of 125 miles. In several cases this is extended to 310, 435 or even greater distances. Germany's own quota is 36, mostly located on the coasts of the Baltic and North Seas. It includes the great experimental station at Nauen, which commands a radius of 1860 miles. In the United States are 20 stations, including Fire Island, Washington, New Orleans, San Francisco and San Juan, P. R. Russia has 17 stations. That of Vladivostok is the most important, commanding a range of 620 miles. Austria-Hungary has 10 stations; Denmark and Spain, each 7; Holland, 6 (that of Scheveningen reaches 435 miles); Norway and Sweden, each 5, etc.

"In non-European lands the system has 4 stations in Argentina, 6 in Brazil, 5 in China, 8 in Cuba (that of Havana commanding 930 miles), 6 in Mexico, 2 in the Philippines, 1 in the Sandwich Islands (at Honolulu). The majority of these land stations are government property and under the control of the postal, naval or lighthouse service.

"Most of the installations are on ocean vessels. Of these 22 are on Dutch and German steamers, while 389 are on warships. They include vessels of the following nationalities: German, 140; Russian, 126; American, 43; Swedish, 19; Austrian, 17; Dutch, 10; Norwegian, 8; Argentinian, 6; Danish, 5; Brazilian, 5; Spanish, 5; Greek, 3, and Indian, 2.

"Fifty-four mobile military stations have been installed in several countries, more particularly in Germany, 14; in America, 8; in China, 5; in England, 4; and in Austria-Hungary, 4.

Long-Distance Transmission by Means of Direct Current.

In the United States, everyone thinks of three-phase alternators and step-up transformers when it is proposed to transmit energy over many miles electrically, but in Europe, as we have frequently noticed in these columns, there is a direct-current system that has been in use for this purpose almost 20 years, namely, the Thury constant-current system, which is in competition with the standard polyphase equipments for all European long-distance transmissions, and has many advocates among electrical engineers.

The longest and highest-voltage Thury direct-current system is the one at Lyons, France, but this has not been operating a sufficient length of time to enable reliable conclusions to be obtained from it. Its immediate predecessor, the Lausanne system, has, however, now been in continuous operation for about six years, and although much shorter and of lower tension, one is able to draw deductions from its service. The energy is obtained from the rapids of the River Rhone, near the little Swiss village of St. Maurice, and is transmitted electrically to Lausanne on Lake Geneva, a distance of 56 kilometers (35 miles) at a substantially constant direct-current strength of 150 amperes and a voltage which varies with the load up to a maximum of about 22,000 volts with 2000 volts drop in the transmission. A detailed description of both the above systems appeared in our pages shortly after operations began.

In broad outline, the Thury direct-current transmission system resembles the ordinary constant direct-current arc-light system, except that instead of lamps, motors are operated in series, and instead of a constant current of 8 or 10 amperes flowing under a pressure of a few kilovolts, there is a constant current of 150 amperes under a pressure of many kilovolts. To supply this pressure, a variable number of 2200-volt generators are connected in series at the generating station, and a similar number of 2000-volt motors are connected in series at the receiving station.

The current is carried on a pair of copper cables supported on a pole line like any other two-wire pair of conductors. Except that the porcelain insulators are about twice the size of the ordinary telegraph insulator and the cables are about 300,000 circular mils in cross-section, there would be little to distinguish the transmission line from an ordinary telegraph or telephone pole line across country. Of course, if the voltages were 60 or 80 kilovolts instead of 20, the appearance of the pole-line would probably be distinctive. At the generating station, each of the turbines drives two direct-current dynamos on its horizontal shaft, through insulating couplings. Each dynamo is series-wound for 2200 volts and 150 amperes at the rated load of 330 kilowatts. The brushes are all definitely fixed in position, and the voltage of each machine is regulated entirely by varying its speed through the control of the turbine connected thereto. In order to distribute the load evenly among the generators, all of the turbines are connected mechanically to one and the same electromechanical governor, so that all the turbines tend to rise or fall in speed simultaneously, unless prevented from doing so individually by independent manipulation. Otherwise, a greater share of the load would tend to fall on those generators whose turbines opened their gates wider and assumed a higher speed. Moreover, unless simul-

taneously controlled, there might be an oscillatory shifting of the speed and load from one turbine to another.

The first salient contrast between the direct and alternating-current transmission generator plant is in the speed of the various units. With alternators, the speeds of all are the same, and the machines are tied together in synchronism. With direct-current generators, the speeds are all variable, and must be controlled simultaneously. With the alternators, the current-strength and phase determine the load. With the direct-current machines, the speed and voltage determine the load. When the load comes on at Lausanne, the tendency is to diminish the line current. This affects the relay mechanism in the main circuit at the generating station at St. Maurice, and automatically opens the gates of all the turbines so as to increase their speed. The speed of all the generators thus increases until the correspondingly increasing total voltage restores the line current to the normal strength of 150 amperes. If the speeds and voltages required exceed the normal, the attendant at the switchboard introduces another pair of direct-current dynamos—that is, another turbine unit—into the circuit.

Each generator is carefully insulated from its neighbor by rubber padded couplings, and from the ground by a flooring of asphalt, above which each machine is supported on porcelain insulators. If these precautions were not taken, it is clear that the full voltage of the system might be thrown on the insulation of one armature winding or commutator. By taking these precautions, the individual commutators are not subjected to serious excess of voltage beyond that generated within each armature winding. This constitutes a second salient difference between the direct-current and the alternating-current, long-distance transmission generator system. In the former, the generators must be carefully insulated from each other and from ground. In the latter, the insulation is confined to the step-up transformers, and the generator frames are ordinarily grounded.

At the receiving station in Lausanne, each motor is directly connected through an insulating coupling to a generator of some kind for supplying the distributing system, and all the motors are series-wound, and in simple series with the line. The generators are ordinary three-phase alternators for the lighting and power distribution, and 600-volt direct-current railway-generators for the city traction. All of these generators are constant-speed and constant-potential machines, so that all of the motors run at substantially constant speed between no load and rated load. For this purpose, the counter e. m. f. of each motor is regulated by varying the position of the brushes. As the load on each motor increases, thereby tending to lower its speed, the speed-governor regulates to restore constant speed, by moving the brushes on the commutator towards a diameter of greater counter e. m. f. Each motor operates constantly with a current of 150 amperes and varies its counter e. m. f. with the load up to a maximum terminal e. m. f. of 2000 volts at rated load. Here again occurs a marked difference between the direct-current and the alternating-current receiving station, which is in regard to speed regulation. In the latter, the motors operate at constant speed and require no auxiliary mechanism to maintain synchronism. In the former, the motors require governing mechanism in order to maintain constant speed.

A principal source of trouble with the direct-current transmission system considered is from lightning on the overhead lines. This is, however, a source of trouble with almost all transmission lines in Switzerland, and there seems to be no reason for supposing that the trouble is increased in the case of a direct-current system. On alternating-current systems transformers are frequently burned out when suffering injury from lightning, while on direct-current systems the armatures burn out. In each case, line insulators are likely to be destroyed.

The strong points of the direct-current system for long-distance transmission are that, leaving surges out of consideration, the maximum e. m. f. that the system must withstand is the working voltage, as indicated by the line voltmeters; whereas in alternating-current systems, the voltage rises in each alternation to 40 per cent more than that shown by the voltmeters. Moreover, the pressure regulation is better because there is no inductive drop and the power-factor is always 100 per cent. All of these advantages relate particularly to the line and have less weight in relation to the power houses and the machinery therein.

The weak points of the direct-current system for long-distance transmission are that the commutation limits the size of the generators and motors to comparatively small units, which are relatively expensive and troublesome. Also the system is not adapted for distribution, but only for the transmission of energy in bulk. Alternating-current systems always admit of being tapped locally, at the mere cost of installing a stationary step-down transformer; but the direct-current system requires a motor-generator and men to watch it. The efficiency of the direct-current system is thus naturally lower than that of the corresponding alternating-current system, even allowing for the losses in the transformers peculiar to the latter.

Summing up, it would seem that as the art of line insulation advances, whereby a good factor of safety can be maintained on the transmission line without excessive cost, the direct-current system cannot compete with the alternating-current system for long-distance transmissions. If, however, the voltages of transmission should press closely upon the means of subsistence—that is, if the insulation along the line could not be commercially maintained with an adequate margin of safety—then the direct-current system is capable of becoming a dangerous rival of the alternating-current system. It looks at present, however, as though the line insulation problem could be satisfactorily dealt with in the future, and thus the alternating-current system is not likely to lose prestige as the best means of transmitting electrical energy.

Mme. Curie on Radium.

A special cable dispatch from Paris of Aug. 17 says: Mme. Curie has just made one of her rare utterances on radium. She resisted all endeavors to obtain her opinion on Sir William Ramsay's reported transmutation of copper into helium, but she has written an interesting reply to François Laur, the French scientist, who questioned Lord Kelvin's assertion before the British Association that radium was a compound body comprising previously known elements. Mme. Curie writes:

"Concerning the formation of helium through radium emanations, I am inclined to share the opinions of Profs. Ramsay, Rutherford and Soddy. I think it probable that radium is an unstable element composed of atoms which undergo spontaneous transformation, and that helium is one of the products of this transformation. Nevertheless, it is possible that helium is produced from gases which surround radium and never are completely removed even in vacuum.

"In either case there is an atomic transformation, but in the second case the radium does not diminish, but acts only by its energy as the determining cause in the transformation. In any event, I do not think there would be any utility in combating Lord Kelvin's opinion. There is no reason why scientific ideas should not be discussed from various points of view.

"My final conclusion is that the outcome of the variety of investigations which are encouraged by discussion every year adds to our knowledge."

In a postscript Mme. Curie adds:

"Radium is a distinct chemical element in the sense attached to the word by chemists. It is unlikely that Lord Kelvin considers radium a compound analogous to other molecular combinations. The discussion probably related more to words than ideas, it being likely that all atoms are complex—formed out of the simpler elements of nature, which are still almost unknown."

M. Laur, in publishing Mme. Curie's letter, contrasts her calm, liberal philosophy with Lord Kelvin's positiveness of statement.

Electrical Exhibition in France.

Mr. John C. Covert, U. S. Consul, calls attention to the fact that the Agricultural, Scientific and Industrial Society, of Lyons, France, is to hold an electrical exhibition in that city in May, 1908. The circular states that the water power of the various mountains in France, the Dauphine, the coast of the Mediterranean, the basin of the Loire, the Eastern Pyrenees, and Auvergne offers over 300,000 horse-power, all tributary to Lyons and all in the neighborhood of a rich agricultural country. The aim of the promoters of the exposition is to discover means of making this immense reserve power accessible for daily use on farms and in the various industries in the cities and villages of all the Midi or south of France, nearly half of the national territory. A similar exposition held in May, 1906, displayed many new electrical exhibits, principally made by Frenchmen.

It is desired that the exposition to be held next year shall include a display of electrical inventions from American exhibitors. An interest in the project has already been manifested in Germany, Italy and England, and it is expected that the exhibits will display in a small space all the progress that will have thus far been made in electrical inventions applicable to the workshop, the field and the household. The circular classes the appliances to be exhibited as follows:

There will be seven main classes of exhibits: Group 1, electrical material for use in farming; group 2, applications to textile industry; group 3, mechanical appliances; group 4, electric lighting; group 5, chemical and thermal apparatus; group 6, production, transformation and distribution of electricity; group 7, diverse applications and telephony. Each of these classes is subdivided.

The grouping given is intended as a suggestive outline and may not be strictly adhered to. Exhibits of an industrial character that may be applied on the farm, in workshops, or in any useful channel will be received, though they may not be directly specified in the circular. The exhibition of this nature given last May in this city was participated in by but few persons outside of France. The promotors of the forthcoming exhibition request Americans to take part in it, and they hope to see the electrical industry of the United States well represented in this city in 1908.

President Roosevelt on Conditions and Corporations.

At Provincetown, Mass., at the laying of the Cape Cod Pilgrims' Memorial Monument on August 20, President Roosevelt made a notable speech, in which he pledged the remainder of the term of his administration to obtaining honest observance of the law of the land in regard to trusts and predatory combinations of capital, against which national legislation has been directed. Mr. Roosevelt intimated his belief that the present sharp decline in the value of securities was due in some degree to deliberate action on the part of those whom the government had brought to book, and he reaffirmed the determination to "punish certain malefactors of great wealth." One of the passages on this point is as follows:

"I wish there to be no mistake on this point. It is idle to ask me not to prosecute criminals, rich or poor. But I desire no less emphatically to have it understood that we have undertaken and will undertake no action of a vindictive type, and above all, no action which shall inflict great or unmerited suffering upon the innocent stockholders and upon the public as a whole.

"Our purpose is to act with the minimum of harshness compatible with obtaining our ends. In the man of great wealth who has earned his wealth honestly and used it wisely, we recognize a good citizen worthy of all praise and respect. Business can only be done under modern conditions through corporations, and our purpose is to heartily favor the corporations that do well.

"The Administration appreciates that liberal but honest profit for legitimate promoters and generous dividends for capital employed, either in founding or continuing an honest business venture, are the factors necessary for successful corporate activity, and, therefore, for generally prosperous business conditions.

"All these are compatible with fair dealing as between man and man and rigid obedience to the law. Our aim is to help every honest man, every honest corporation, and our policy means in its ultimate analysis a healthy and prosperous expansion of business activities, of honest business men and honest corporations."

After the delivery of the speech there was a notable recovery and firmness in stock quotations.

Tremendous Indictment of an Electrical Union.

A sensation has been caused in the electrical field in New York City by the report to the Supreme Court of Mr. W. J. Kenney, the receiver, on the management of the New York Electrical Workers' Union, an organization which has managed to inflict infinite loss and annoyance on those having do with electrical construction on Manhattan Island. The report, which is voluminous, declares that "thousands of dollars have been taken by the officers and other members of the union, in disregard of the law of the state." In suggesting a remedy, Mr. Kenney says of these officials and members: "It seems to me useless to pursue them in the civil courts. They are now dependent upon what they earn from day to day. Judgments against them would be worth nothing." Mr. Kenney proposes that a meeting of the union be called for the second Wednesday in September for the election of a new set of officers and directors, the affairs of the union to be put into their hands, as those at present existing are not, according to the report, "in number or qualification, fitted to disburse the money of the union under the law."

The report goes on to say that the union from its start headed for disaster, there being no attempt made to comply with the law which provides for the appointment of a trustee to keep a duplicate record of money received by the financial secretary. No trustee was ever appointed. The record of this union is one remarkable personal treachery and dishonesty. Within a year there was a revolt against its president. He was charged with dishonesty, and indicted, but was acquitted about a month ago. Then there were two factions in the union, both of which collected money from the members.

"After resigning his presidency," Mr. Kenney says, "this indicted ex-president was employed in 'special representation' of the union and spent hundreds of dollars of the union's money. He was lavish in expenditures, but saving in itemization." Dealing with the financial end of the union, Mr. Kenney says: "In September, 1905, Webster H. Storer became treasurer of the union, and C. A. Krause financial secretary. Both remained in office until they were put out by order of the Supreme Court last April. After three months of mutual accountancy they opened a new set of books, starting without a cent to the credit of the union, apparently. Mr. Krause says the quarred of the factions had reduced the union's income to nothing. Mr. Storer says nothing. He has disappeared. So have the books.

Analyzing the accounts, Mr. Kenney finds that from the date of the opening of the new books until March, 1907, $39,835.50 was collected from members. Of this, $35,712.21 was paid out, $19,298.20 being paid to "functionaries of the union who did, or pretended to do, work for the union." The principal amounts paid were: John J. Maddocks, president, $3,374.29; Carl A. Krause, financial secretary, $3,177.67; Richard Kirwan, agent, $2,381.80; M. J. Heller, special agent, $2,413.03, and Webster H. Storer, treasurer, $978.42. Outside of this $19,298.20, an additional $4,746 was paid to O'Neil & Shay, lawyers. Commenting on these payments, Mr. Kenney

says: "The president of the union is entitled to $100 a year. John Maddocks, the ousted president, from December, 1905, to March, 1907, received $3,374.29."

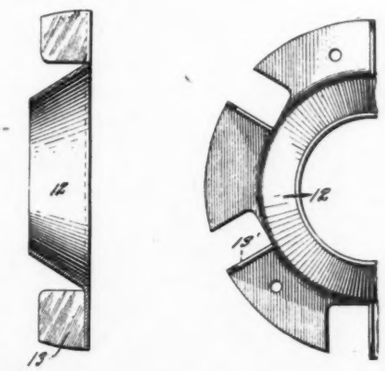
The report gives in detail a number of similar incidents, and then goes on to tell of the efforts made by Mr. Kenney to locate Storer. "Treasurer Storer ought to explain discrepancies between himself and Secretary Krause which appear," adds Mr. Kenney, and he concludes his report by saying: "The business of this union was pursued without system. Its money was handled by persons who had no right to touch it."

Toledo Convention of the O. E. L. A.

During the present week from Aug. 20 to 22, the 13th annual convention of the Ohio Electric Light Convention is being held at Toledo, Ohio. The session on Tuesday forenoon was devoted to the presentation of the presidential address by Mr. W. P. Engle, the discussion of papers on factory lighting by Mr. A. P. Biggs, and Mr. J. Kermode, and the reading of the report of the committee on uniform accounting by Messrs. F. E. Crawford and D. W. Low. During the afternoon session on Tuesday, the paper by Mr. H. P. Grabhill was read and discussed, and the report of the committee on electric heating devices was heard. For Wednesday forenoon arrangements were made for the reading of a paper, by Mr. J. Robert Crouse, on co-operative commercialism in the electrical field, and a paper by Prof. F. C. Caldwell, on the best form of power for stations of 500-kw capacity or less. The afternoon session on Wednesday was to be devoted to the reading and discussion of the report of the committee on high-efficiency lighting units and the report of the committee on cost determinations, and to the presentation of papers on help to a solicitor, by Mr. Frank Munsell, Mr. J. D. Kenyon and Mr. A. S. Miller. In addition to the reading of the report of the secretary and treasurer and the election of officers, the presentation and discussion of four papers on the best way to meet gas and gasoline competition were arranged for Thursday morning. The last official meeting was to consist of an executive session on Thursday.

Forced Cooling of Dynamos.

Although the fact that the load which a certain motor or generator can carry continuously is limited largely by the facilities for cooling with which the machine is supplied, has been known even from the days when the first machines were being constructed, yet only within relatively recent years have manufacturers appreciated the great value of employing forced ventilation for such machines. The present trend of thought in this direction is well illustrated by a patent recently issued to Mr. Henry G. Reist, of Schenectady, N. Y. The inventor equips the rotating member with large outwardly extending fan blades for producing an adequate circulation of air throughout numerous ducts within the rotating and stationary cores. Two views of the ring carrying the fan blades are given in the accompanying illustration.



FIGS. 1 AND 2.—SIDE AND END VIEWS OF FORCED-DRAFT FANS.

CURRENT NEWS AND NOTES.

AMERICAN ELECTRO-CHEMICAL SOCIETY.—Subject to revision, the fall meeting of the American Electro-chemical Society will be held in the building of the Chemists' Club, New York, on Oct. 10, 11 and 12. The programme will comprise several papers on the electrometallurgy of iron and steel, including one by Dr. Haanal, who has made a thorough study of the subject for the Canadian Government. Among the topics for discussion will be the subject of the corrosion of iron and steel considered from the electrolytic standpoint.

RESTRICTING SECURITY ISSUES.—The Public Utilities Commission has formulated and given out rules applicable to the issuance of stocks, bonds, notes and other evidence of indebtedness by public utilities corporations in New York state. The object apparently is to prevent "stock watering," and the path is made a difficult one to pursue. A company has to throw open its books and prepare a variety of minute statements even to secure a hearing as to any proposed increase of capital. These rules have immediate effect, and will determine the result of several applications from electric traction and lighting corporations.

ROBERT FULTON CELEBRATION.—The first trip of Robert Fulton up the Hudson from New York to Albany, Aug. 17, 1807, in the tiny paddle-wheeler *Clermont,* was duly celebrated on the Hudson River, on the anniversary, last Saturday; but there will be more elaborate and formal exercises next month in New York and at the Jamestown Exposition. All the Albany Day Line boats had ceremonies in honor of the occasion. One hundred and thirty engineers of the Robert Fulton Association of the N. A. S. E., sat down to a memorial banquet on the evening of Aug. 11 at King's Retaurant, Chicago. Speakers of the evening dwelt upon Fulton's work, hailing his gift to the world as one of the greatest in history. Mr. Royal D. Tomlinson, ex-president of the National Association and supervising operating engineer and condenser expert for Allis-Chalmers Company, responded to the toast, "Engineers, Then and Now." Mr. John W. Lane, editor of the *National Engineer,* spoke on "Robert Fulton;" George N. Carmen, director of the Lewis Institute, responded to "One Hundred Years of Steam," and Charles W. Naylor, chief engineer for Marshall Field & Co., had for his subject, "A Look Into the Future."

THE TELEGRAPH STRIKE.—The telegraph strike has now got well into its second week, and the companies have steadily been increasing their forces and the numbers of offices reopened. So far as can be judged from practical experience there is now little if any delay on the lines, and to an outsider in the great cities there would appear to be no strike at all. The Government has declined to intervene in the matter. President Small, of the telegraphers' union, is trying to raise a strike fund of $10,000,000 and to stir up an agitation for government ownership of telegraphs. In the meantime, the strikers are beginning to talk about arbitration, and Samuel Gompers, of the American Federation of Labor; John Mitchell, of the United Mine Workers, and Daniel J. Keefe, of the International Longshoremen's Union, have been appointed arbitrators for the Commercial Telegraphers' Union, provided the companies can be persuaded to arbitrate the questions which were the prime cause of the strike. Unless conditions vitally change, these gentlemen will not have much to do, as the representatives of the companies have repeatedly stated that they would not arbitrate, having no question on which to arbitrate. In fact there has not yet been any public statement of grievances.

OKLAHOMA INDEPENDENT TELEPHONE ASSOCIATION.—The semi-annual meeting of the Independent Telephone Association of Oklahoma was held at the Lee Hotel, Oklahoma City, on Aug. 13. The following officers were elected: L. T. Hine, of Purcell, president; J. W. Wilson, of Oklahoma City, vice-president; L. D. Spencer, of Pauls Valley, secretary and treasurer. The next meeting will be held in Oklahoma City, in February, 1908.

THE BEST BURGLAR PROTECTION.—The Chicago central-station companies have, in their recent advertisements, quoted a statement recently made by Chief Shipply, of the Chicago police force, to the effect that a lamp constantly burning in the house is the best protection against burglars. The turn-down type of electric lamp is, of course, suggested as the one with which it is easiest to carry out this plan, as it cannot blow out when turned low as will gas and it is very economical to operate.

ATLANTIC WIRELESS.—It is announced from London that the Marconi Wireless Telegraph Company will be prepared for a wireless telegraph service between Ireland and Canada in September. This was confirmed at the offices of the company in this city. The company lately has made great improvements in its station at Glace Bay, which has been moved to a more favorable situation and much enlarged. The station at Clinton has also been improved in order to meet the situation. The first stations erected were found to be too small for the purpose, and therefore the improvements. For some time past the company has had communication across the Atlantic, and exhaustive tests have been carried on which have been entirely satisfactory. Mr. Marconi, when here some months ago, was confident of the fact that the establishment of the commercial service would soon take place, but at that time no announcement was made, as he wished to have the result of the test first. The company's ordinary rate will be 5d., and the press rate 2½d., plus land charges. The present rate by the ordinary cable companies is 25 cents per word.

N. E. L. A. BULLETIN.—President Farrand, of the National Electric Light Association, has signalized his new administration by the issuance of a handsome eight-page bulletin, the first number of which has just appeared. It will be devoted to the promotion of intercourse between the officers and the members, particularly in cases where information is desired from standing committees. The objects of the bulletin are admirably defined in two editorial articles of an explanatory character and inviting co-operation. A large part of the issue is, and will hereafter be, assigned to the "Question Box," so as to make it of current, continuous value, and Mr. Alex. J. Campbell, of New London, Conn., the editor, presents two pages of live topics. Answers will be printed usually two months after the topic has been made a subject of inquiry. This issue contains also Mr. W. H. Blood, Jr.'s, review of the New York fire insurance decisions. The bulletin is printed in excellent type, and is altogether worthy of the high standard reached by the Association in its other publications. We can readily believe that it will be found an extremely useful medium for disseminating Association intelligence and securing new members.

THE MILWAUKEE MUNICIPAL PLANT.—A lively fight is being waged in Milwaukee over the building of a municipal electric light plant. The plant has been under consideration for some time, and in fact the city went so far as to have plans and estimates made. In the meantime the city closed a five-year contract with the Milwaukee Electric Railway & Light Company at $65 per lamp per year. The company offered to furnish light at $60 per lamp per year or cheaper, if the municipal plant at Detroit could be shown to be furnishing light for less than $60. In short, for a ten-year contract, the company offered to duplicate any price that Detroit might set in its municipal plant. The city having made a satisfactory contract with the electric light company, many citizens formerly in favor of the municipal ownership movement considered that the municipal movement had outlived its usefulness and that the project of building a plant should be dropped. There is still a radical element which is trying to build the plant at an expense of $1,500,000, and is blocking all other improvements that are demanded by the public. Comptroller Bechtner has come out against the plant and refuses to countersign any of the orders.

ELECTRICAL COMMUNICATION.—Mr. Charles A. Conant, the financial expert, has in an article in the *Bankers' Magazine* some interesting data and references with regard to the use and value of electrical communication in the financial world. It was said that New York brokers were paying as much as $1,000,000 per year for London dispatches with the installation of the first working cable in 1866. Twenty words to London then cost $100, as compared with $5 to-day. At present it is the estimate of cable officials that fully 95 per cent of all messages sent are in code, and that 1000 messages come from the financial district daily. On land the electric telegraph has contributed its share in bringing together the markets of the world. The system of stock tickers, now installed in nearly all the brokerage offices and in leading hotels and other places where men gather throughout the country, has made the news of transactions on the Stock Exchange as nearly instantaneous as the advance of present day science permits. In addition to Stock Exchange quotations, which are carried to nearly 2000 tickers in Greater New York and Jersey City, there are 100 machines reporting the grain and produce quotations, and there are additional hundreds in Chicago and other leading cities of the country. The telephone has doubled and perhaps trebled the working efficiency of all those classes of men who decide important questions by a word and leave the details to their subordinates. On the Stock Exchange alone business aggregating over $100,000,000 per day is transacted by telephone.

WIRELESS FOR FRUIT STEAMERS.—Advices from Washington state that officials and representatives of the United Fruit Company, a Boston concern, controlling a large part of the trade in West Indian fruits, have had a meeting by appointment with Secretary Taft in furtherance of their application for permission to erect a wireless telegraph station at Point San Antonio, on the extreme westerly end of Cuba. They stated that they were operating one hundred vessels between the United States and the West Indies and Central America, and from the nature of their business, involving the handling of vast quantities of perishable fruits, it was essential that the ship captains should be in constant and immediate communication with headquarters. Already the company had established a number of wireless stations, in the gulf and Caribbean waters, including those of Port Limon, Costa Rica, Bocas del Toro, Columbia, Bluefields, Nicaragua, and Gracios a Dios, and Puerto Cortez, in Honduras, and Belize, Yucatan. A station at Point San Antonio was necessary to secure full benefit from many of these other stations, as a relay was essential to the operation of the longer circuits. It appears that the application for the permit was originally made to the present Government in Cuba, but its approval had been withheld for the reason that that Government has projected a general system of wireless stations on the coast of Cuba, including one at Pinar del Rio, only sixty miles distant from the point selected by the United Fruit Company as a site for its station, and it was feared there would be "interference" to an extent that would make the Government station valueless. Secretary Taft, after hearing the arguments, decided that he would issue to the company a revocable license, subject to the approval of Gov. Magoon, so that the station might be discontinued at any moment if it interfered with the Cuban Government station.

PEKIN TROLLEYS.—The bulletin of the U. S. Department of Commerce and Labor states that a plan for the construction of a tramway line at Pekin elaborated by a Japanese has been presented to the Bureau of Foreign Affairs by the Japanese minister at Pekin. He demands a monopoly of ten years, after which the concern may be bought by China.

GOVERNMENT WIRELESS.—It is stated that, foreseeing possible dangers to the Government in time of conflict of a general strike of telegraph operators, officials of the War and Navy Departments have begun to formulate a plan for extending the wireless system of the navy and the development of a complete system in the army, including army posts across the continent as well as on army transports. It is expected that a meeting of the joint army and navy board will be called soon to consider the proposition and make recommendations for its being carried out.

POWER FOR NEW YORK.—In an interview in London, Comptroller Metz is credited with the following statement: "As for the water supply, I am convinced that New York will sooner or later have to filter its water or sterilize it in some way. In Germany I studied the process of ozonizing water electrically. This is now done successfully in several towns, but on a much smaller scale than will be necessary in New York. By utilizing the fall of water at the Croton Dam, however, it is estimated that the city will have 700,000 horse-power at its disposal, and this will furnish enough electricity to ozonize all the city's water and furnish plenty of light, too. The problem of engineering is one which I shall study on my return home."

TARIFF REVISION is being taken up in some unexpected quarters. The National Association of Manufacturers, an organization of some 2700 manufacturers, with a combined capitalization exceeding $15,000,000,000, publishes in the current issue of its official organ, *American Industries,* a tariff "creed" emphasizing the resolution in favor of immediate tariff revision, unanimously passed at a recent convention. The association holds that present tariff schedules are unequal, and demands the immediate appointment by Congress and the Executive of a non-partisan, non-political commission, composed of men thoroughly competent to equalize present schedules.

VICIOUS POLES.—The subjoined item is funny, but appears to have been published in good faith. Some people feel that the way in which poles "get up and go for" automobiles is a crime that must be punished and stopped. "Telegraph and telephone poles are becoming absolutely dangerous to automobilists, and a national agitation for the removal of the poles from the roadside is not at all unlikely. The papers of the country report daily accidents to motorists caused by the poles. Cars break steering knuckles and escape the control of their drivers, or they escape by other means, and the telegraph or telephone pole is usually their finish. With the poles removed it is not improbable that the fatalities in automobiling would be decreased by half or more."

CANADIAN TELEPHONY.—The second annual convention of the Canadian Independent Telephone Association will be held at the City Hall, Toronto, on Wednesday, Sept. 4. An interesting programme is being prepared, and the following are expected to address the convention, viz.: Theo. Garey, of Missouri, president of the International Telephone Association; J. B. Ware, secretary, Michigan Independent Telephone Association, Grand Rapids, Mich.; J. A. Harvey, secretary, International Telephone Association; Dr. J. F. Demers, National Telephone Company, Quebec, and others. Matters affecting the independent interests will be discussed, including those of legislation, exclusive agreements, the formation of provincial or district associations after the Ohio plan, etc.

TO CONSIDER TRUSTS.—Questions affecting the relations between State and National governments and corporations will be discussed at a national conference on combinations and trusts to be held in Chicago on Oct. 22, 23, 24 and 25. This conference will be held under the auspices of the National Civic Federation. It is announced that 41 governors of states and the commissioners of the District of Columbia have appointed delegates to attend the meeting. Many governors have signified their intention of attending the conference in person. The delegations as appointed are made up of representative citizens of the various states, including senators, congressmen, attorneys-general, ex-governors, members of state railway commissions, newspaper editors, attorneys, college presidents, labor leaders, manufacturers, farmers, cattle growers, merchants and bankers.

INSULATING MATERIAL FOR RHEOSTATS.—A patent issued Aug. 13, to Mr. H. Ward Leonard, describes certain combination materials that are stated to be particularly advantageous for supporting the resistor in a rheostat or electric heater. One suitable composition consists of three parts of fluorspar ground to about 60 mesh, and four parts of a vitreous material made by fusing together two parts of red lead, two parts of borax and one part of flint, the vitreous material being ground to a fine powder. The fluorspar of the composition has a coefficient of temperature expansion higher than that of cast-iron and higher than the coefficient of a resistor made from an alloy of substantially 60 parts of copper and 40 parts of nickel. The vitreous material of the composition has a coefficient of temperature-expansion less than that of cast-iron or of the copper-nickel alloy.

A SCHOOL FOR TELEGRAPHERS.—With the object of supplying a sufficient number of railway telegraphers to enable the Pennsylvania Railroad to comply with the new national law, under which railway telegraphers are permitted to work only nine hours a day, that company has announced that it will establish a school of telegraphy at Bedford, Pa. The students of this school will be instructed in the duties ordinarily performed by station agents. They will acquire a knowledge of practical railroading while pursuing their studies in telegraphy. Train orders and other telegrams handled often over railway telegraph wires will become familiar to these operators before they attempt actual work on the railroad. The Pennsylvania Railroad east of Pittsburg and Erie employs over 3000 operators, and it is estimated that 700 additional telegraphers will be required before the company will have enough men to comply fully with all the requirements of the new law, which goes into effect March 1, 1908.

RADIUM CURES.—U. S. Consul Thomas H. Norton, of Chemnitz, reports that the growing importance of radium as a therapeutic agent has led the management of the Imperial Uranium Works, in St. Joachimsthal, Bohemia, to construct a special laboratory for the industrial production of radium compounds. The consul continues: "The uranium ores of this locality contain higher percentages of this mysterious element than any other known deposits thus far investigated. The ores and the residues from the uranium extraction have hitherto been treated chiefly at Paris, where the method for isolating the minute traces of radium was perfected by Madame Curie and her lately deceased husband. There will be manifest advantages in carrying out the extraction at the place of origin, in view of the enormous amounts of rock required for the production of a tiny fragment of a radium salt. Interesting, likewise, is the fact that an extensive sanatorium is being erected in the same locality, where patients can take baths in the water pumped from the uranium mines. This water seems to be sufficiently charged with radium compounds in solution to exert a distinct therapeutic action, and physicians have already begun to prescribe its use."

MISSOURI TELEGRAPH LAW.—At Chillicothe, Mo., on Aug. 17, the Burlington Railroad Company was found guilty of violating the eight-hour telegraphic law and was fined $200 by Justice Crall. An appeal was taken. This is the first conviction obtained under the law passed at the last session of the Legislature and which the railroads declare conflicts with federal statutes.

THE HOPKINSON METHOD.—With regard to the recent interesting correspondence in our pages, as to early knowledge and publication of the Hopkinson method of charging for electrical energy and service, our attention has been called to the fact that at the Cincinnati convention of the National Electric Light Association, in 1902, Mr. Arthur Williams gave a brief and succinct description of the system. It will be found on pages 443 and 444 of the volume of transactions of that year, and was headed "The Hopkinson Method." Mr. Williams also supplemented this by a pertinent discussion of rates.

CHILIAN TELEGRAPHS appear to be in an active condition and the state lines show a gain in 1906 over 1905, the messages sent having been 1,926,285 and 1,505,483, respectively. The receipts were about $274,617 United States gold for 1905, and $367,793 for 1906, a gain of $93,176. The average cost of a telegram was about 19 cents United States gold. The Government made a liberal appropriation for the betterment of the service for 1907. There are but few private lines in the country. The international telegraph line between Chile and Argentina showed a gain of $18,502 over 1905. A new cable is being put in over the Andes, 3 to 4 feet deep in the ground, to protect the line from the severe storms and snowslides. All the telegraph and telephone supplies are imported, even to the poles, a large number of which are iron.

PARIS OMNIBUS SERVICE.—According to cable dispatches from France, the Municipal Council of Paris has decided to let the omnibus service of the city, provided the concessionaire will employ electric carriages, charge 10 or 20 centimes (2 or 4 cents), according to distance, appoint fixed stopping places, and pay the city 4½ per cent of its gross earnings. Moreover, the new concessionaire must give its employees a share in the profits, but not by way of an increase in salary. The share is to be paid into two funds, the sick and benefit fund, and the pensions fund, the former of which will also receive contributions from the company of 6 per cent of the total wages paid, and from the employees of 2 per cent of the wages received. Salaries are to be paid by the month. The minimum wage is fixed at $30. Each employee is to have four holidays a month and ten consecutive days' leave each year.

ELECTRICITY ON A MODERN STEAMSHIP.—The latest addition to the North German Lloyd Steamship Company's twin-screw express fleet plying between New York and Bremen, Germany, is the "Kronprinzessin Cecilie." The electrical equipment of this modern and fleet ocean greyhound consists of five 100-kw, 100-volt generators which supply the electricity for 3100 incandescent electric lamps and other electrical apparatus on board. The smoking rooms and cafés contain electric cigar lighters, and the state rooms are provided with plugs and connections for small electric fans and curling irons. In addition all of the outside rooms as well as suites and cabines de luxe are heated electrically. A complete telephone line connects the bridge, the engine room and after bridge, the bridge and look-out on the mast, the captain's room, all the officers' and chief steward's rooms, the pantry and all suites and cabines de luxe. When at the wharf the telephone system is connected with the land telephone system so that local and long distance calls may be made from the telephones on board the ship. The steamship is in addition equipped with a long distance wireless telegraph outfit.

POST OFFICE MANAGEMENT.—The New York Post Office is understood to be well managed, but that complications of an expensive character occur is indicated by the following from the New York *Times*: "The New York Post Office is particular in the conduct of its huge business, and particularly so in regard to money matters. To give just one instance in proof of this it may be said that a daily report of business done is sent from all the branch offices in the city to headquarters downtown. Should a mistake be detected in the financial statement in the way of a shortage or a surplus, the office from which it emanates is notified of the fact by telephone. It makes no difference if a shortage, say, should amount to only one cent or even a mill; the branch responsible is promptly called up by 'phone—and every ring-up, be it remembered, costs Uncle Sam 7 cents—and the error adjusted. Errors in the financial statements, however, are, as a rule, surprisingly few, and the sums concerned usually small. Rarely, indeed, is the shortage or surplus above ten dollars. It has happened on at least one or two occasions that after all such errors in the daily financial reports had been adjusted, the expense of the telephone calls totaled up to a little more than the entire amounts involved."

FORCING PLANT LIFE.—A special cable dispatch from London says: "A series of important experiments destined to revolutionize the production of crops of fruit and flowers under glass, and enable the gardener to obtain both in a much shorter period of time, as well as at a considerably less cost than heretofore, have just been begun in the Royal Botanic Gardens, Regent's Park. By means of a powerful arc lamp moving automatically along a trolley wire overhead, light is diffused over the plants directly the solar light fails. This movable lamp is surrounded by water, so that the rays may resemble those of the sun both in quality and movement. Besides, no part of the plant is entirely in the shade. By means of earthenware pipes connected with the engine, moist air, containing the carbonic acid required for the sustenance of the plants, is diffused in carefully regulated quantities through apertures into every part of the house, while in iron pipes heat is also diffused to maintain the desired temperature. But more important still is an electrostatic machine which is made to supply electrical energy to the soil to convert insoluble nitrates into soluble nitrates, and otherwise enable the roots of the plants to have an abundance of food prepared in a form capable of ready assimilation. A Mr. Thwaites is the inventor of the process."

PRODUCTION OF MICA.—In an advance chapter from the "Mineral Resources of the United States, Calendar Year 1906," Douglas B. Sterrett, of the United States Geological Survey, reports the production of sheet mica in the United States for 1906 as 1,423,100 pounds, valued at $252,248, and of scrap mica as 1489 short tons, valued at $22,742. These figures show an increase over those for 1905 of 498,225 pounds in quantity and $91,516 in value for sheet mica, and of 363 tons in quantity and $4,886 in value for scrap mica. The imports of mica into the United States in 1906 were the largest ever recorded, the value being considerably more than twice as great as in 1902 and 1905, the years that formerly held the record. According to Mr. Sterrett, the total quantity imported and entered for consumption in 1906 amounted to 3,066,738 pounds, valued at $1,042,608. The total production and consumption of sheet mica in the United States in 1906 was 4,489,838 pounds, as against 2,519,445 pounds in 1905, an increase of about 78 per cent. A comparison of the import figures with those of the home production shows that there is a wide field for the extension of the industry in the United States, and indeed the industry is expanding rapidly to meet the demand. Deposits carrying mica in commercial size are found in many parts of the United States, from the Atlantic coast to the Pacific, and new developments are reported each year.

Kern River No. 1 Power Plant of the Edison Electric Company, Los Angeles—III.

AT the time work on the Kern River No. 1 plant was commenced five years ago, no plant of its size had been constructed for impulse wheel work. Units exceeding 2000-kw in output were extremely rare and for a long time it was supposed that 2500-kw units would be selected for this station. When, however, specifications were issued, many larger units were in successful operation and prices were requested on machines of 4000 and 5000-kw normal output. No difficulty was anticipated, nor was any experienced in securing generators of this size, but the water-wheel equipment presented a more difficult problem. Some manufacturers were willing to undertake the building of wheels having an output of 10,000 horsepower from a single nozzle, but the large size required, and the extremely crowded placing of the buckets rendered necessary if the unit was to be of reasonable dimensions, seemed to the officials to indicate that such a construction would be less efficient than the arrangement finally employed.

WATER WHEELS.

The water wheels selected for the Kern River No. 1 plant are of the impulse or tangential type. There are eight wheels installed, two for each of the four generators. The two wheels for each unit are overhung, one on each end of the generator shaft, the unit being of the two-bearing type. The water is projected onto the buckets of the wheels through deflecting nozzles of the needle-valve type mounted at the end of the 28-in. branch pipes. By means of these deflecting nozzles and needle valves the discharge from the tip of each nozzle can be accurately regulated without altering the form of the jet to any appreciable extent.

The wheels are designed to run at 250 r. p. m., and the two wheels on each unit are guaranteed to deliver a total of 10,750 horse-power to the generator shaft. Regulation of the wheels is obtained by means of self-contained oil-actuated hydraulic governors of the Escher-Wyss type, working under 125 lbs. pressure. The rotary oil pump immersed in the oil reservoir of each of these governors is operated by a Morse silent-running chain driven from the generator shaft. The governors act on the nozzles and deflect the stream off from, or onto, the buckets of the wheel as the load on the generator is decreased or increased. The governor for each unit is placed midway between the two nozzles and is connected to a common rock shaft which, in turn, actuates the two nozzles by means of rocker arms. These shafts are below the main floor and are accessible through a longitudinal shaft alley or tunnel 5 ft. wide and having a clear head room of 6 ft. 9 ins.

The nozzles are equipped with needles for adjusting the size of the stream by hand. For convenience in construction and to permit of balancing them for backthrust, the needles are straight-backed, running through a guide sleeve of their full diameter into a balancing chamber supplied with water from the pressure side. The needle then reduces to a steam and passes through a second stuffing box, beyond which the control links are attached. The needles are torpedo-shaped, being 8 ft. long, 12 ins. in diameter at their full diameter and 8½ ins. in diameter at the stem. The tip is about 25 ins. long and is carried down to a blunt point on straight lines. The needle is operated by means of a hand-wheel on the main floor, the wheel stand also supporting a pressure gauge connecting with the nozzle and the two pipes connecting the two sides of the nozzle body with the balancing chamber of the needle. Each nozzle throws a jet 7⅝ ins. in diameter at full opening.

The nozzle casting is bifurcated, the design being adopted to permit of bringing the needle stem out without offsetting the nozzle as is done in other types of deflecting needle nozzles. The strain on the ball-joint bearings is equalized in this construction. The nozzle is a heavy steel casting, the Y portion weighing 15 tons. A counterbalancing plunger is located at the lower end of each operating lever below the nozzle. The needle stems and part of the tips are of steel. Some cast-iron tips have, however, been supplied and it is expected that they will wear as satisfactorily as the steel ones.

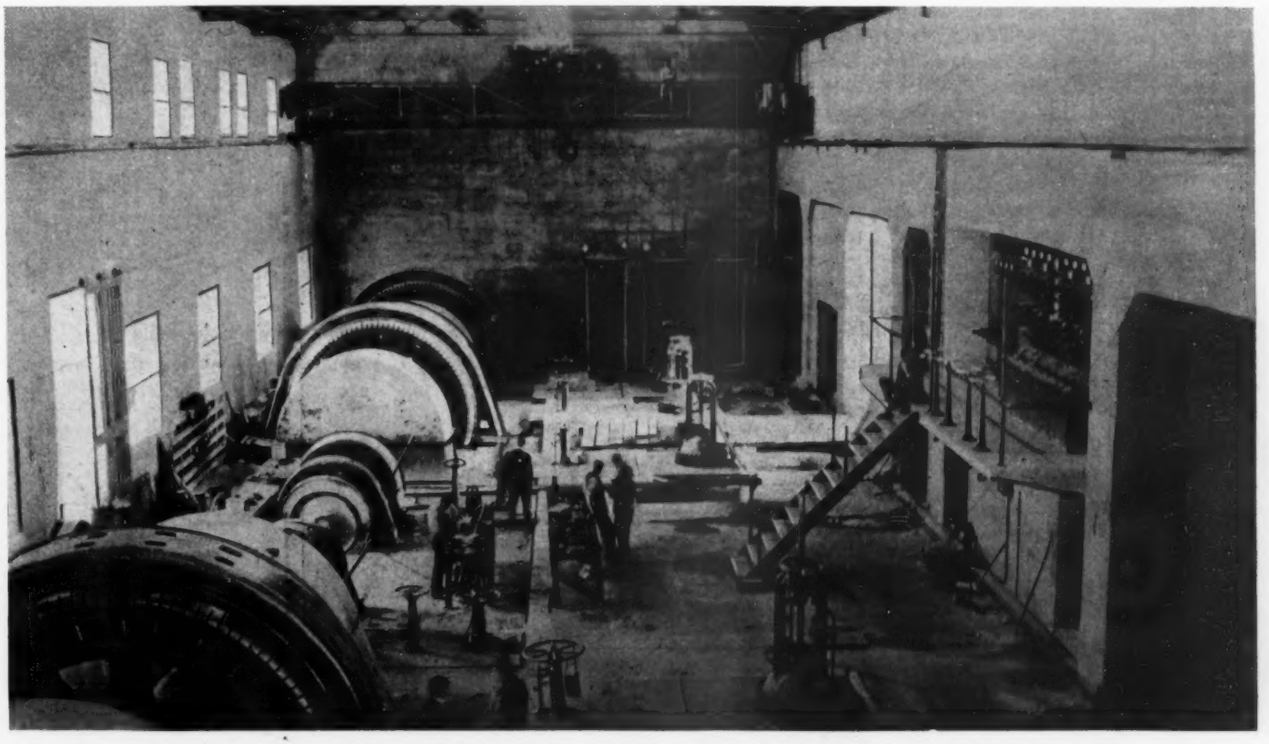


FIG. 22.—INTERIOR VIEW OF POWER HOUSE SHOWING THREE MAIN UNITS AND ONE OF THE EXCITER UNITS.

Each of the revolving elements of the wheels is 9 ft. 8 ins. in diameter, and consists of a cast-steel rim to which are bolted 18 bronze buckets. These buckets are 27½ ins. wide and are not radically different in form from modern buckets used elsewhere on the Pacific Coast, being in general of an ellipsoidal shape,

with a straight front wall and a dividing wedge that dips down toward the front of the bucket.

The housings of the wheels are of cast iron with graceful lines, and where the shaft enters are fitted with compound baffle plates or water guards to prevent water escaping from the housing.

The mechanical and hydraulic design of these wheels was carefully checked by the engineers of the Edison Electric Company before the manufacturers were allowed to proceed with their construction. The combined moment of inertia of the revolving element in the two water wheels and generator of each unit is $WR^2 = 1{,}800{,}000$ lbs. ft.^{2}, by means of which regulation at 100 per cent load variation is obtained within less than 8 per cent when the units are carrying 50 per cent overload, and within less than 5⅓ per cent variation of speed when running at normal load. The guarantee requires that the water wheel proper shall develop an efficiency at rated load of 82½ per cent, which guarantee is to be substantiated by tests conducted by the company.

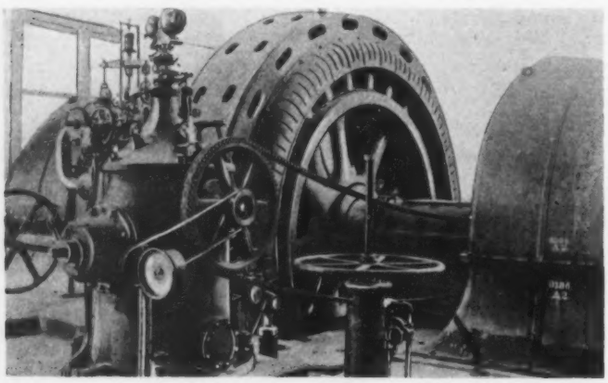


FIG. 23.—5000-HP WATER WHEEL GENERATING UNIT.

GOVERNORS.

When the governor arrangement for the water-wheels was designed, the leading idea was to have each turbine with its respective governor form an independent unit. Although the available operating water pressure of 370 lbs. from the force main is ample to operate governors, it was preferred to substitute oil pressure. This precaution is fully justified, as long years of experience in operating hydraulic governors has proven that the safety is rather questionable, and the wear and tear of the parts of regulating valves causes a constant expense for repairing and replacing parts, which necessitates shutting down the respective units. It was also deemed preferrable not to feed the governors with oil pressure from a central system, but to make each governor absolutely self-contained. The oil pressure used is 125 pounds per sq. in.

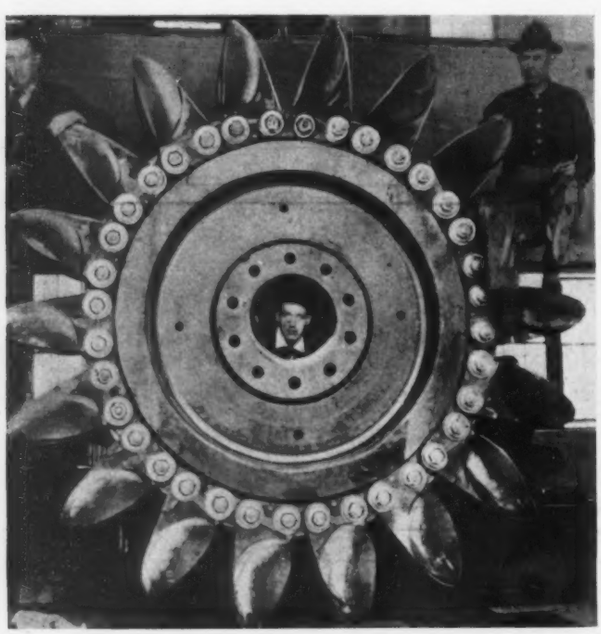


FIG. 24.—REVOLVING ELEMENT OF 5000-HP WATER WHEEL.

Special attention was paid to the safe operation of the units, eliminating from the beginning any tendency to run away. For this purpose, the arrangement of the generator, as well as the exciter governor, was made in such a manner that the jets will be automatically deflected from the buckets whenever the oil pressure in the governor should fail.

The weight of the two deflecting nozzles for each unit is partly carried by a hydraulic balancing piston placed midway between the nozzles, which receives water pressure directly from the force main. The governor arm connects by means of a link to a common rock shaft, which, in turn, actuates the two nozzles by means of rocker arms. The design of the connection is such that as soon as the oil pressure in the governor fails, the nozzle will lower on account of the unbalanced weight, and thus deflect the jet from the buckets. The same result is accomplished with the deflecting hood of the exciter wheels, which is connected to a hydraulic water piston, tending always to insert the hood and thus deflect the jet.

Each governor is driven by a Morse silent-running chain from its wheel shaft. The connections between the operating pistons and the deflecting nozzles or hoods consist of levers, pins, links and shafts. The use of gears or racks has been avoided, thereby preventing jars which would result in lost motion and wear and tear.

Attention may also be called to the fact that all constituent parts, as well as all accessories, are attached or combined with one main casing, the advantage being that each governor can be assembled and thoroughly tested in the factory, and shipped completely assembled to its final destination. The main casing contains the main operating cylinder with piston and mechanical hand-regulating device.. The oil pump is attached to the casing and immersed in the oil reservoir. It is of the rotary type, having no valves which are often the cause of failure of oil pressure. The main pump shaft also carries the bevel gear which drives the fly balls operating the pilot valve over the regulating lever. The pilot valve is self-contained between opposing pressures, and any reaction upon the fly balls is eliminated. It is evident that this is a principal condition for exact regulation. The pilot valve distributes the oil pressure in the regulating cylinder. The motion of the regulating piston is reversedly transmitted to the regulating valve by means of a combined compensation. The leverage of this compensation is adjustable, so that the governor may be set for any load-speed characteristic, from 16 per cent to absolutely constant speed.

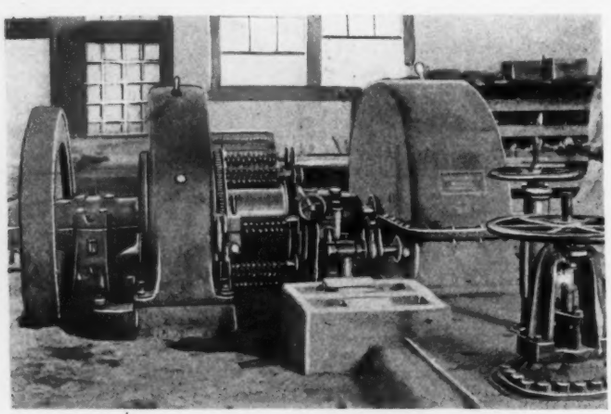


FIG. 25.—EXCITER UNIT.

The governors are equipped with four regulating devices

which can be used at any time. 1. Mechanical hand regulation (without oil pressure). 2. Automatic regulation with fly balls. 3. Hand regulation with oil pressure (fly balls disconnected by a clutch coupling inserted between pump shaft and fly ball shaft). 4. Hand regulation with oil pressure and electric motor operated from the switchboard. (Synchronizing attachment.)

The exciter governors are of similar design, except that they are not provided for electric hand regulation.

There are two exciter units, each being of the two-bearing type, with an impulse water wheel on one end and a heavy fly-wheel designed to give the unit close regulation on the other end of the shaft. The exciter wheels are operated from stationary needle nozzles, the needles being of the same straight form used on the main wheels. Regulation is obtained by oil governors of the Escher-Wyss type, which operate stream deflectors that are pulled up into the stream from below as the load on the unit decreases, thus deflecting a part or all of the stream into the tail race. The exciter wheels are of a construction similar to the large wheels, having 20 bronze buckets 9⅜ ins. wide bolted to the rim of the runner. All the water wheel equipment mentioned above was supplied by the Allis-Chalmers Company.

The Lombard Governor Company has furnished for the plant one of its type N governors for operating one of the main units and a type Q governor for one of the exciters. These governors are of the vertical oil-pressure type and the order includes the necessary reservoirs, pumps, etc. The Edison Electric Company has used Lombard governors in its other hydroelectric plants and is desirous of determining the relative performance of the two types of governors in its Kern River No. 1 plant.

GENERATORS.

The main generators are of General Electric manufacture and have a rated output of 5000 kilowatts each. The stationary armature is bar-wound for 2300 volts, three-phase, 50-cycles. Each main unit is provided with two 16 in. x 48 in. babbitted bearings, each fitted with six oil rings. In the pedestals the oil is cooled by means of water coils. Each bearing also has in its lower portion a number of small openings which are connected to a triplex motor-driven pump, capable

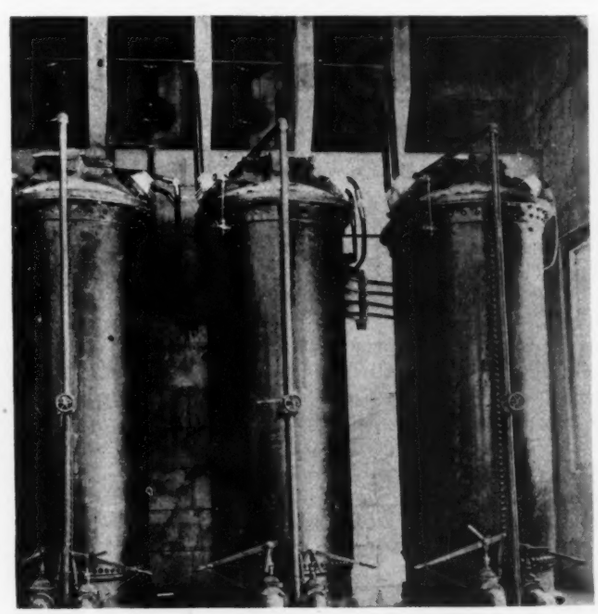


FIG. 26.—BANK OF THREE 1667-HP TRANSFORMERS.

of circulating the lubricating oil under a pressure of 1000 lbs. to the square inch.

The generator shaft is flared out at each end to form a flange to which is bolted the wheel disk. The shaft is also enlarged at the center to carry the cast-steel pole rim and spider. This latter is a single casting weighing 26 tons. The pole pieces are wedged to the exterior of this rim.

The exciter units are standard 225-kw, direct-current machines, generating at 125 volts, flat compounded, running at 430 r. p. m., and have ordinary self-adjusting bearings. Sufficient space has been left between the two exciters to permit the installation of a large induction motor at some future time if it should be found necessary. This motor would be designed

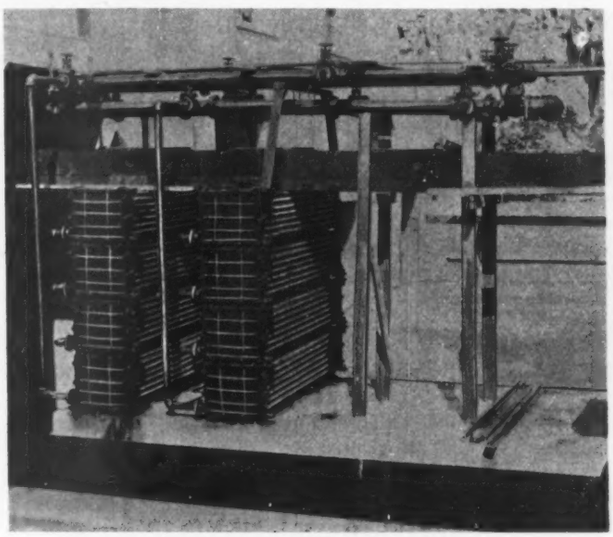


FIG. 27.—COOLING COIL FOR CIRCULATING TRANSFORMER OIL.

for good speed regulation and arranged so that it could be connected by means of a pair of clutches to either of the exciters.

OUTPUT OF THE PLANT.

The normal rated output of the Kern River No. 1 power plant is 20,000 kilowatts. The machinery is tested to operate under 50 per cent overload for peak load service, thus making the maximum capacity of the installation 30,000 kilowatts.

TRANSFORMERS.

The station contains 13 50-cycle, 1667-kw oil-filled, shell-type oil-circulated one-phase transformers in boiler-iron cases. These transformers are grouped in four banks of three each with one spare to receive power at 2300 volts delta from the generators, and to supply it to the line at 75,000 volts Y. Taps are also provided for the intermediate voltages of 56,250 and 37,500.

These transformers, instead of having internal water cooling coils, are so built that when the oil is supplied to them under a slight pressure, it will automatically distribute itself throughout their windings and return itself by gravity to the waste pipe. The piping and connections for this circulation, which are placed in the basement of the power house, consist of a 4-in. supply line, a 6-in. return line, and a 4-in. waste. These principal pipes are placed in a tunnel 7 ft. 9 ins. wide and 11 ft. high, extending the length of the building.

The oil coming from the transformers enters a receiving drum from which it is drawn by two 5-in. centrifugal pumps, driven by 15-hp variable-speed, shunt-wound, direct-current motors. Either pump can supply oil to the entire equipment of transformers in an emergency. These pumps force the oil through a set of boiler-tube coolers, set over the tail race, consisting of a series of 2-in. pipe, 10 ft. long, made up in four sections containing 1008 tubes, and having a total area of 4500 sq. ft. Only two of these sections are at present installed. From these cooling coils the oil returns to the pressure line from which it is supplied to the transformers.

This system has been carefully laid out with strainers, by-passes and other auxiliaries so that the entrance of any foreign substances into the oil will not cause trouble. As the system is under pressure from the time the oil enters

the pump, any leakage will be outward and there will be no possibility of water leaking into the oil, as is the case where the water coils under pressure are placed in oil-filled transformers. The oil is specially refined. Another advantage of a system of this kind is that the cost of installation is somewhat less than for a similar installation using water cooling.

Water for the cooling sections is by-passed from one or both of the exciter tail races into a flume built across the top of the coolers.

ELECTRIC DETAILS OF STATION.

The generator leads pass through ducts, under the station floor, to the generator switches, and from thence to the low-tension side of the transformer banks. The station is not equipped with a complete 2300-volt bus-bar system. There are, however, motor-operated oil tie switches placed between adjacent machines and equipped with double-throw switches in such a manner that in case of necessity any generator can be transferred by means of this transfer line to any single transformer bank, or, in case of absolute necessity, run in multiple with some other generator on a single transformer bank, or, if desired, the entire station can be tied together by means of this transfer bus and operated as a single unit.

The transformer banks connect on their high-tension side through knife-blade switches to a single bus-bar, which is sectioned in the middle. The two outgoing transmission circuits are tapped off this bus-bar between adjacent transformer banks through motor-operated oil switches. These switches are remote-control, non-automatic. By use of them and the section oil switch, all high-tension power switching can be handled without the use of air-break switches. At the same time, the investment for high-grade switching is reduced to a minimum. The 2300-volt oil switches are installed in cells with concrete barrier walls and tops. The disconnecting switches for them are also separated by barrier walls where possible. The 75,000-volt oil switches are not only installed in concrete cells in accordance with standard practice, but each of them is enclosed in a separate concrete room containing no additional apparatus except lightning arresters.

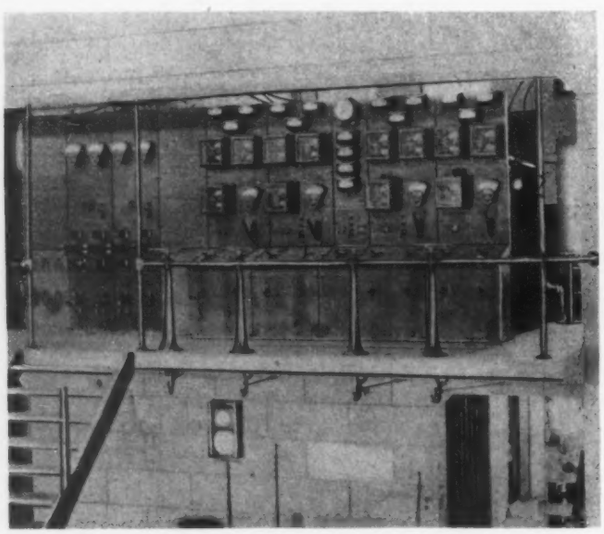


FIG. 28.—CONTROL SWITCHBOARD.

The control switchboard is mounted on a gallery overlooking the machine room. It is built of black slate and is a combination bench and panel board, consisting of nine divisions. The first panel on the left controls the station auiliaries, the feeder for which is taken off the two center sections of the 2300-volt bus through solenoid-operated oil switches and then through two solenoid-operated oil switches to the panel.

The second and third panels are equipped for handling the exciter circuits, and each is provided with a Thomson Astatic ammeter, a voltmeter and two single-pole, double-throw knife switches for connecting the exciter to either of the two exciter buses. The panel also has two double-pole, double-throw switches for connecting the exciter bus to the station lighting circuit and to the operating buses which control the oil-switch motors, the lamps on the control board and other auxiliaries.

Panel No. 4 is blank, while Nos. 5, 6, 8 and 9 are generator panels. Each of the latter is equipped with three Thomson ammeters, a field astatic ammeter, a curve-drawing ammeter, a curve-drawing voltmeter and a curve-drawing wattmeter.

The seventh panel is the auxiliary feeder, bus-sectionalizing and station panel. It contains a synchronism indicator and two voltmeters on the synchronizing bus, an ammeter on the ground circuit and an ammeter on the auxiliary feeders.

FIG. 29.—HIGH-TENSION LINE DISCONNECTING SWITCH AND CHOKE COIL.

The bench of the switchboard has controlling switches with red and green signal lamps for each of the four generators, and there are also provided control switches for each of the two 2300-volt feeder switches, for the switches on the 2300-volt bus sections and for the 75,000-volt outgoing line switches. The base of each generator bench panel has one governor control switch and a double-pole, double-throw control switch for operating the two 28-in. valves on each water-wheel unit.

On the six-panel rear switchboard are mounted five Thomson polyphase watt-hour meters, break switches and disconnecting switches on the field circuits. A curve-drawing frequency-registering meter, driven by a ¼-hp motor is also installed.

All of the electrical equipment in the station, including generators, exciters, transformers, lightning arresters, oil switches, switchboards, etc., was supplied by the General Electric Company.

The high-tension wiring is run in 4-ft. square ducts throughout, no open wiring being permitted except connections from transformers to the wall through their disconnecting switches, and from the lightning arresters disconnecting switches to the lightning-arrester banks.

The lightning arresters are of multiplex type, consisting of alternate carbon spark-gaps and resistance. The circuits are equipped with choke coils, consisting of 20 turns, of hard-drawn copper. The lightning arresters are, as stated above, mounted in concrete wall cells, and are so completely isolated from each other by the intervening main-line ducts that an arc starting on any single arrester could not by any possibility be transferred to a second bank.

The leads, after passing the choke coils and taps for the lightning arresters, pass out of the south wall of the building through rectangular openings located immediately below the eaves. To prevent the drip from the long run of roof from falling on the wires, a gutter extends for a few feet across the roof above each entrance. From the eaves of the building, the leads converge on to the first tower of the transmission line.

TRANSMISSION LINE—ROUTE.

From the power house the transmission line runs in as near as may be a straight line to the mouth of the Kern River Canyon, 2½ miles distant, where it sweeps off to the left across the Cottonwood Hills, and then takes a due south course across the edge of the Bakersfield plains. The line then enters the mountainous section through Tejon Canyon, follows across the end of Castaic Lake, and crosses the Coast Range divide immediately above German Station.

This is the steepest portion of the transmission line, as the

drop from the top of the hill to the road below is over 1000 ft. in 3500 ft. From here south the transmission line follows the waters of Piru Creek and its tributaries, the character of the country changing gradually from low, rounded hills with grassy slopes, to deep narrow gorges walled with precipitous shale cliffs capped with sandstone ledges.

A section here of about 5 miles involved very difficult work. Heavy angles, both vertical and horizontal, were necessary in a district where no permanent wagon road could be maintained, and where the tower footings were mostly in loose shale. One U-bend of the river was crossed by means of a 2250-ft. span between the main supports, guided by an entirely unloaded tower at the bottom of the sag. This heavy work was mostly executed in the middle of winter to the considerable disadvantage of the work.

Leaving the Piru Canyon, the line passes in an almost straight line across about 15 miles of rocky land covered with scattered oaks and chaparral. After reaching the last crest of this district, the line falls away rapidly to the open country surrounding Newhall. Across this entire district it was necessary to construct a permanent wagon road to haul supplies and permit of patrolling the line during operation. The maximum

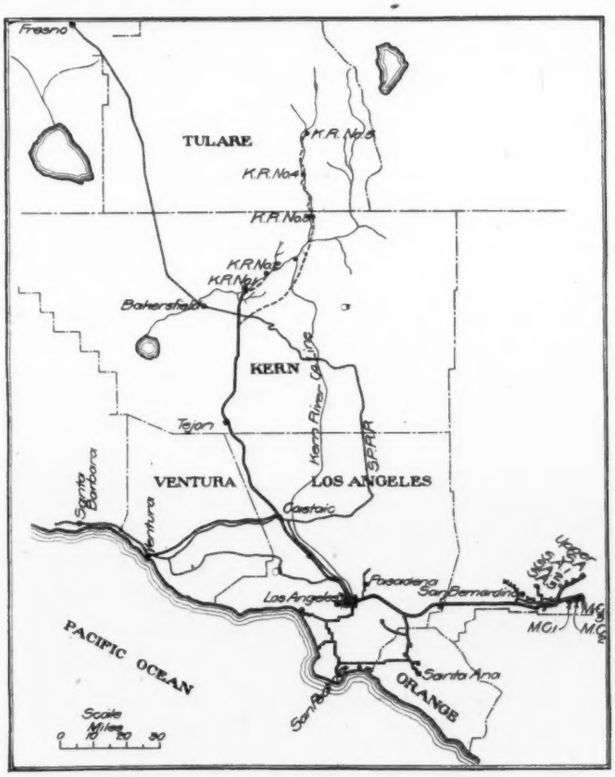


FIG. 30.—MAP OF TRANSMISSION LINE.

grade facing the heaviest haul was held down to 10 per cent, whereas the maximum grade in the opposite direction was allowed to become 20 per cent in one special case. The ruling grades in both directions are much lighter, not averaging over 5 per cent.

One bridge having two 48-ft. spans was constructed at the head of Violin Canyon (Palomas) to avoid making an extensive fill. Piru Creek, which is subject to extreme floods on occasions, was crossed by a number of fords so located as to be readily repaired after freshets, it not being considered desirable to maintain a permanent wagon road in this locality.

In the Newhall district, the line crosses the San Fernando Mountains directly west of the long tunnel on the Southern Pacific. Beyond this point it is in sight from the railroad track most of the way to Los Angeles, and throughout the greater portion of the route the line is erected in the open country, so that in case of necessity the line can be repaired without excessive delay.

Electric Locomotive of the New York, New Haven & Hartford Railroad.

OUR issue for Aug. 10 contained a complete review of the reasons assigned by Mr. E. H. McHenry, vice-president of the N. Y., N. H. & H. R. R., for the selection of single-phase, high-potential locomotives for hauling trains throughout the "electric zone" of New York City. There also appeared a description of the details of the catenary line work for supplying energy to the locomotives. The locomotives were discussed in our issue for April 14, 1906. We are pleased to be able to give below some additional information concerning the service requirements for which the locomotives were designed and the numerous constructive details embodied in the locomotives which are in successful use at the present time.

In the adaptation of electric traction to the New York, New Haven & Hartford Railroad, a number of features were presented by the problem which required months of study, and which practically fixed the system which should be adopted, and to a large degree decided the design of both the locomotives and the line construction. Aside from the innumerable details which had to be considered, broadly speaking, the problem called for:

A system, the first cost and maintenance of which would not be prohibitive; a system which would permit of large extensions with a high degree of efficiency at a reasonable cost, and locomotive equipments which would be capable of operating over the direct-current lines of the New York Central Railroad.

After a most exhaustive study of the problem from all points, the single-phase alternating-current system was decided upon

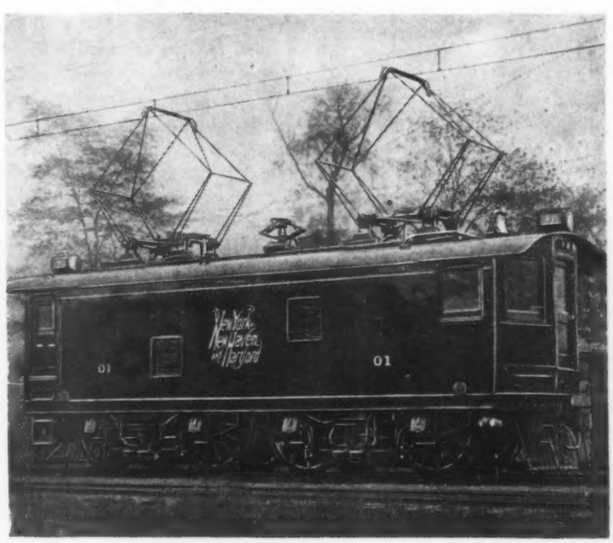


FIG. 1.—VIEW OF NEW HAVEN LOCOMOTIVE WITH PANTOGRAPH TROLLEYS IN USE.

as being the only existing system which would successfully meet all of the conditions imposed.

The alternating-current system was primarily selected on account of its facilities for transmission and transformation, and single-phase was decided upon because the characteristics of the single-phase motor make it eminently suitable for railway work, and also on account of the simplicity of the line construction.

SPECIAL REQUIREMENTS.

The specifications under which the locomotives were sold require that each of them shall be able to handle a 200-ton train in the most severe schedule on the present time-table, corresponding to the local express which stops about every 2.2 miles and operates on a schedule speed of over 26 miles per hour. This service requires a maximum speed of about 45 miles per hour. The locomotive is also to haul this weight of train at from 65 to 70 miles per hour and a 250-ton train at 60 miles

per hour in the long runs. Three hundred-ton, or even heavier, trains may also be handled on the long runs at reduced speeds. Heavy trains may be operated at high speeds by coupling two or more of the locomotives together and operating them on the multiple-unit system.

DESIGN.

The design of the locomotives was largely dictated by certain requirements: (a) gearless motors having a flexible drive and with all the weight carried on springs were desired and finally adopted as the most desirable form, and (b) operation on 600 volts direct current necessitated the use of four motors in order that they might be operated in the usual series-parallel relation.

Having these two requirements in view, the mechanical design of the locomotive follows as a natural consequence. The bogie truck type was adopted after very careful consideration as the one best adapted to meet the conditions imposed. It is well known that its riding qualities are of the best and it offers the least resistance in taking the curves in the line.

LOCOMOTIVE FRAMES.

The mechanical parts of the locomotives, which are entirely of steel, were built by the Baldwin Locomotive Works from designs developed with the co-operation of the Westinghouse Electric & Manufacturing Company and the New York, New Haven & Hartford Railroad Company engineers. The locomotive measures 36 ft. 4 ins. over bumpers, and weighs approximately 90 tons.

The longitudinal members of the frame consist of deep plate girders reinforced at the top by channels and at the bottom by heavy angles and plates. To these frames are riveted plate cross members, one over each truck, forming the transoms for the transmission of weight to the center-pin. These transoms are further braced by gusset plates riveted to the bottom flanges of both sets of channels, which transmit the tractive power from the center-pin to the side frames. The side girders are placed outside the wheels as low down as the wheels and drawhead will permit and are braced and squared by substantial steel flooring plates, which are riveted to the top flanges. The draw-bar effort is transmitted to the side frame through deep box girders joining the frames at the ends of the locomotive.

The cab is built up on a framework of Z-bars which are riveted to the side girders. This whole design forms a very light but extremely strong construction, able not only to transmit large draw-bar pulls, but to resist heavy shocks in bumping.

TRUCKS.

The running gear consists of two trucks, each mounted on four 62-in. driving wheels. The trucks have side frames of cast steel to which are bolted and riveted pressed steel bolsters which carry the center plates. A very strong construction is secured without excessive weight by the use of bolsters 30 ins. wide at the center plate and extended to nearly double that width at the ends, which are bolted to the side frames. Center bearings 18 ins. in diameter transmit the tractive effort to the frame. They are well lubricated to permit free motion on curves. The weight on the journal boxes is carried by semi-elliptic springs. Under the ends of the equalizer bars are small spiral springs to assist in restoring equilibrium. The distance between truck centers is 14 ft. 6 ins.

ELECTRIC AND MAGNETIC CIRCUITS OF THE MOTORS.

As mentioned in our issue for April 14, 1906, the propelling motors of the locomotives are of the conductively-compensated single-phase, series type. For the direct purpose of improveing the power factor, the magnetomotive force of the current in the armature is counterbalanced by an equal magnetomotive in stationary coils placed in the field core structure through which the armature current is required to pass. If the so-called compensation were complete, then the armature circuit and the stationary compensating coils as a unit would form a non-inductive circuit consisting of a certain resistance and no reactance. Due, however, to the magnetic leakage between the armature and the compensating coils the combined circuits contain a small reactance component in addition to the resistance.

It is noteworthy that by far the largest portion of the reactance of the motor circuits is found in the main field coils. As a rough approximation, it may be stated that at synchronous speed the tangent of the angle of lag (of which the cosine is the power factor) is equal to the ratio of the effective field turns to armature turns, and it decreases inversely with an increase in speed. Hence, with well designed armature and compensating coils, the power factor can be rendered quite high by using a small ratio of field to armature turns and operating the machine at a speed which is high in comparison with synchronism.

The requirements for obtaining a high power factor are well met when the field is made magnetically very weak and the armature correspondingly strong, and a large number of poles is used. The improvement in the power factor by using a weak field will be appreciated when it is remembered that for a certain field current the field flux varies as the first power, and the field reactance as the square of the field turns. The advantage of using a large number of poles resides in the fact that the magnetomotive force for producing the field flux is distributed throughout a large number of coils of few turns (and hence having a small reactance) rather than concentrated in a few coils having a much larger total reactance.

Incidentally, when a large number of poles is used, "synchronous" speed occurs at a low rotative speed. If an increase in the number of poles did not, from mechanical considerations, entail a corresponding decrease in the rotative speed it would be possible to improve the power factor of the motor by changing the ratio of the operating speed to the synchronous speed. It is to be noted, however, that, except insofar as an increase in the number of poles may allow a smaller pole-pitch or a higher peripheral speed to be used, no improvement in power factor is obtained from a change in the ratio of the operating speed to synchronism, because no such change takes place.

The motors on the New Haven locomotive are provided with 12 poles, so that the synchronous speed for 25-cycle current corresponds to 250 r. p. m. Since the locomotive drivers are 62 ins. in diameter, 250 r. p. m. corresponds to a locomotive speed of 4060 ft. per minute, and at synchronous speed the locomotive runs at 46 m. p. h.

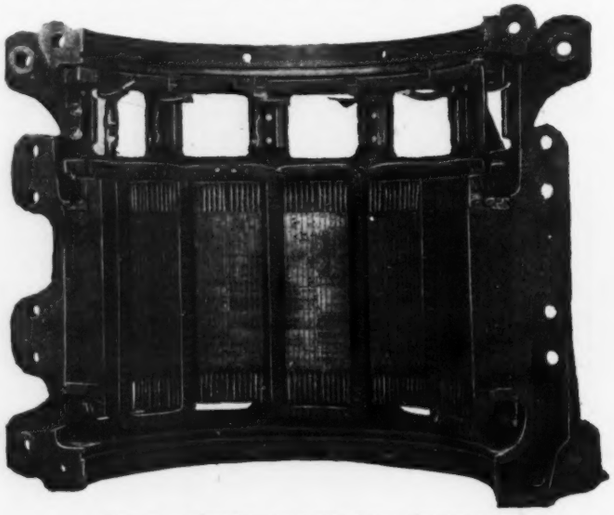


FIG. 2.—INTERIOR OF FIELD-CORE STRUCTURE.

It is instructive to note that if the motor had 14 poles, and the drivers were 72 ins. in diameter, synchronous speed would again correspond to 46 m. p. h. with 25-cycle current; if, however, the frequency were lowered to 15 cycles, synchonous speed would occur at 27.7 m. p. h. Moreover, if the same motor were used for 15 cycles as for 25 cycles, at synchronous speed in each case, the tangent of the angle of lag would be the same; at the same locomotive speed in each case the tangent of the lag angle would be reduced in the ratio of 25 to 15, or as 1 is to .6.

It should not be inferred from the statements made above either that there could be any very considerable improvement made in the operating characteristics of a motor by changing from 25 to 15 cycles, or that the performance at 25 cycles is unsatisfactory. The fact of the matter is that the power of a 25-cycle motor is so high that even a very great reduction in the tangent of the lag angle produces a relatively small effect on the operating characteristics. Assume, for example, that at a certain speed the power factor for 25 cycles is 90 per cent; the angle of lag is 26 degs. and its tangent is .483. If the same motor is operated at the same speed with 15-cycle current, the tangent of the lag angle is .289, the lag angle is 16 degs., and the cosine (the power factor) is .96. Thus, the power factor has been increased by only 6.7 per cent. In any event, whether the motor is operated at 25 cycles or 15 cycles, its power factor will be better than that of a corresponding induction motor.

It will be noted from the facts discussed above that the prime object in compensating the armature magnetomotive force is to improve the power factor, and not to prevent sparking during alternating-current operation (as is frequently stated). At a certain speed and field strength the sparking depends upon the amount of current to be commutated, so that an improvement in the power factor, which results in a reduction in the current required for a certain power at a certain e. m. f. does to a limited extent improve the commutation; but the minute reduction in sparking is of secondary consideration. During direct-current operation of the motors the current in the compensating coils prevents a distortion of the field by the armature m. m. f., and hence it removes a portion of the cause for sparking at high speeds. To the extent that the alternating-current motor possesses the disadvantageous sparking characteristics of a direct-current motor, the compensation improves the commutation. Since the sparking in the alternating-current commutator motor is largely attributable to the transformer action of the field flux which is surrounded by the armature coil under the brush, it may be stated that in the prevention of sparking in such motors the compensation of the armature m. m. f. plays an unimportant part. The means for the prevention of sparking, which are confined to the armature itself, will be discussed below.

A view of one-half of the field core structure, with both the compensating and the main field coils in place is given in Fig.

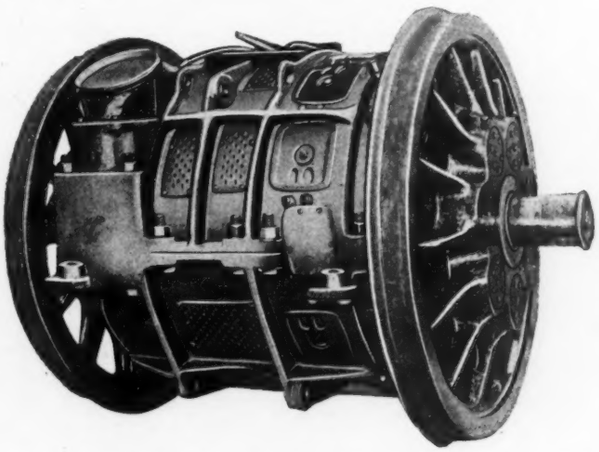


FIG. 3.—MOTOR COMPLETE SHOWING THE VENTILATING ARRANGEMENT.

2. It will be noted that there are five complete field poles and two half-poles. Thus the field core structure is divided through the middle of two field poles, and not between certain adjacent poles, as is done with the ordinary four-pole direct-current railway motor. The object in thus arranging the divisions is attributable to the existence of the compensating coils whose conductors are imbedded in the pole faces and whose end connectors pass between the adjacent poles.

It will be noted that there are 12 slots in each pole face; the conductors in six slots of each pole are joined directly to the conductors in the nearer six slots in the adjacent pole. To have divided the motor between adjacent poles would have necessitated the unsoldering and resoldering of 24 connectors in the compensating coil circuits. By dividing through the center of two poles, only a single connector of the compensating winding need be disturbed.

The splitting of the field core structure through the pole face has rendered desirable a slight change in the arrangement of the main field winding in order to minimize the disturbance to this winding when the two halves of the field structure are separated. Only one-half of the projecting pole cores are surrounded by main field coils, the magnetic poles at the other cores being of the "consequent" type. Thus only one connector in the main field circuit is disturbed when the field cores are separated.

Such an arrangement as the one here indicated might prove objectionable if the magnetic density over the pole area reached the saturation point of the core material. The field is magnetically very weak, however, and very little unbalancing of the poles takes place. Even when the field is strengthened for direct-current operation, the unbalancing is in itself of no great consequence. Moreover, the armature winding is connected at various equipotential points to "balancing rings," such as are commonly used in direct-current machinery, and no detrimental effect can be produced by a tendency to considerable unbalance in the magnetic fields.

ARMATURE.

The most striking feature of the armature is its appearance of compactness and stability. It differs from the ordinary direct-current armature in that the main winding is completely closed on itself, and connections to the commutator segments are made through resistance leads. The leads are tapped to the armature winding at the end of each turn, so that there is one armature turn per commutator segment. The object in inserting resistance between the armature coils and the commutator segments and in using only one turn per coil, is to overcome the sparking.

Each armature coil in its mechanical position when its commutator segments are under the brush is electromagnetically in the relation of the secondary circuit of a stationary transformer of which the primary circuit is the main field coil; there is generated by transformer action in each secondary turn an e. m. f. proportional to the product of the main field flux and the frequency. The advantages of using a single turn per armature coil, a weak magnetic field and a low frequency will be noted at once. The e. m. f. generated in the single armature turn under the weak magnetic field at 25 cycles is low in value, but in an armature of the ordinary design it would produce a large value of current locally in the circuit including one armature coil, two commutator segments and the double-brush contact. The resistance of the leads, however, serves to limit the short-circuit current to an allowable safe value and to prevent detrimental sparking at the commutator.

As the preventive resistance leads are arranged so as to be non-inductive, the short-circuit current is approximately in time-phase with the transformer e. m. f. in the armature coil, or in time-quadrature with the main armature current; moreover, the current in the coil undergoing commutation can be reversed most readily when the circuit of the coil is non-inductive. It will be seen, therefore, that the preventive resistance leads are well adapted to minimize the causes for sparking.

Since the main line current passes through two resistance leads in parallel, it is evident that some loss is occasioned by the presence of the leads. An excess of resistance would cause an enormous loss due to the main current, but would reduce the short-circuit current to an insignificant value; a deficiency of resistance would render the loss due to the main line current negligible, but the short-circuit current loss would be excessive.

The resistance of the leads used on the motors of the New Haven locomotives is so selected that neither the loss due to the short-circuit current nor that occasioned by the main line cur-

rent is large, while the sum of the two is reduced to a satisfactory minimum.

The resistance leads are covered with insulating material similar to that used on the main armature winding and are placed in slots beneath the armature winding proper.

ARMATURE VENTILATION.

Although, as stated above, the armature structure is very compact, ample provision has been made for ventilation and cooling. Experience has shown that the most effective method of cooling dynamo-electric machinery is to embed the insulated coils snugly and compactly in the mass of iron and then to keep the iron cool. Iron is an excellent thermal conductor, and it serves to extract the heat from the coils through the insulating material more readily than is possible when air is depended

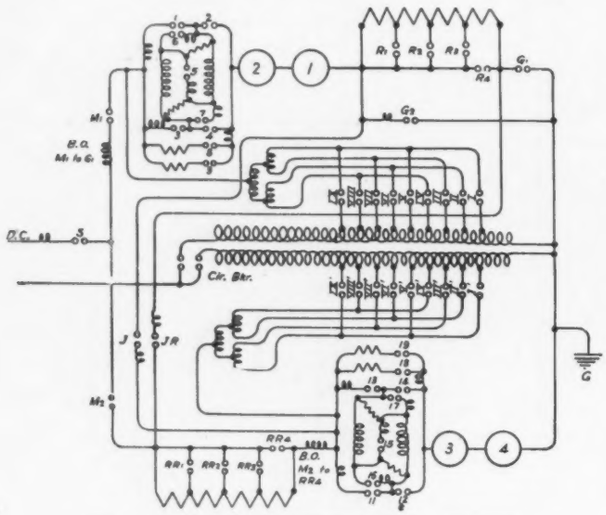


FIG. 4.—DIAGRAM OF MOTOR-CONTROL CIRCUITS.

upon to draw the heat from the coils. Advantage is taken of the knowledge of this fact in the arrangement of the coils and core of the motor armature. Numerous ducts are provided throughout the armature core structure through which air is forced for cooling the iron to which the heat is conducted from the armature coils and preventive leads. The air also passes through and around the commutator and serves to remove from it both the heat produced there by friction and I^2R losses and that thermally conducted to it from the resistance leads.

A view of the completed motor, indicating the means employed for cooling, is given in Fig. 3. The circular opening at the top is normally connected through a canvas hose to a source of supply of air under a pressure of several ounces per square inch. In entering the motor structure the air is required to pass through a filtering screen and to the openings in the armature spider, from which place it flows outward around the commutator and through the ventilating ducts of the armature and along the air-gap to the openings to the outer atmosphere, shown as perforations in sheet metal plates on the field core in Fig. 3. The forced-draft method of cooling has proved extremely effective. To guard against the remote possibility of clogging of the air ducts or some enforced stoppage, an electrical pyrometer with its thermo-elements in the motor structure and its indicating mechanism in the locomotive cab is used for showing continuously the temperature within the motor. By means of the pyrometer the motorman can ascertain when the service is too severe for the equipment or when the supply of air has been interrupted.

CONTROLLER CIRCUITS.

A schematic diagram of the motor-control circuits for both direct-current and alternating-current operation is given in Fig. 4. It will be noted that the armatures of the four motors are arranged in two groups, the two armatures of each group being connected permanently in series and controlled as a unit. During direct-current acceleration the motor units are connected in series and then in parallel, while during alternating-current operation each motor unit receives power at variable voltage from a separate auto-transformer.

Although not indicated on the diagram, the various switches are so inter-locked that the circuits used exclusively for alternating current cannot become active during direct-current working, and those intended solely for use during direct-current operation are inactive when alternating current is used. It is sufficient for present purposes, therefore, to discuss the direct-current and the alternating-current circuits separately, without any relation to each other.

DIRECT-CURRENT CONTROL CIRCUITS.

During direct-current operation switches 5 and 3, 2 or 1, 4, according to direction of travel, of one motor unit, and switches 15 and 12, 13 or 11, 14, according to direction of travel, of the other motor unit are kept closed so that the main field circuits of each motor unit are connected at all times in series with the respective armatures. At the moment of starting, switches S, M and JR are closed, thus connecting the two complete motor units in series with each other and with eight sections of resistance. As the speed increases, switches R_1, R_2, R_3 and R_4 of one motor unit, and switches RR_1, RR_2, RR_3 and RR_4 of the other unit are closed in succession, thereby increasing the voltage impressed on each motor unit until the two units are in series across the line without resistance. Switch 8 of one unit and switch 18 of the other are then closed simultaneously, thus placing a resistance in shunt to the field windings and thereby increasing the speed by weakening the magnetic fields. The motors being of the compensated type permit of an enormous weakening of the fields at the commutators. The fields are further weakened by the simultaneous closing of switches 9 and 19, and the speed becomes accelerated to considerably more than one-half of the normal running value.

The next movement of the controller handle opens switches 8, 9, 18 and 19 (thereby increasing the strength of the fields); closes switch J; opens switch JR, and closes switches G_1 and M_2, thus subjecting each motor unit in series with four resistance sections to the full value of the supply potential. It will be noted that the transfer from full series to multiple connection is accomplished without opening any motor circuit, and without short-circuiting either motor unit. Higher speed points are obtained by closing switches R_1, R_2, R_3 and R_4 and switches RR_1, RR_2, RR_3 and RR_4 in pairs successively until the full multiple position of the controller is reached.

ALTERNATING-CURRENT CONTROL CIRCUITS.

During alternating-current acceleration no resistance whatsoever is used, the speed changes being obtained by impressing

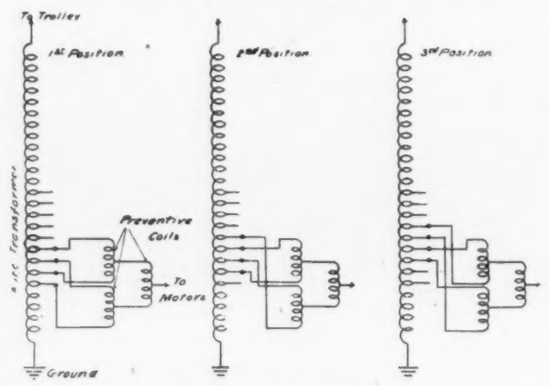


FIG. 5.—SIMPLIFIED DIAGRAM OF AUTO-TRANSFORMER CIRCUITS.

variable voltages obtained from auto-transformers directly upon the terminals of the motor units. There are two electrically and mechanically distinct auto-transformers, one for each motor unit. Referring again to Fig. 4, it is to be noted that when alternating current is used the main line high-tension circuit breaker and switches 6, 7 and 1, 4 or 3, 2, according to direction of travel, of one motor unit, and switches 16, 17 and 11, 14 or 12, 13, according to direction of travel, of the other motor unit are kept closed during operation. It will be seen, therefore, that the

main field circuits of the two motors of each motor unit are placed in parallel; thus the field magnetism per armature ampere is less during alternating-current operation than during direct-current operation (neglecting the fact that at times the field circuits are shunted for extra acceleration with direct current).

There are six running points with alternating current, each corresponding to a certain voltage impressed upon the motor circuits. For changing from one voltage point to another on each auto-transformer, use is made of three small so-called "preventive coils." These preventive coils are essentially auto-transformers, having a ratio of 2 to 1. It will be observed that the motor unit receives current from the middle connection of one preventive coil whose outer terminals are joined to the middle points of the two other preventive coils; the outer terminals of the latter preventive coils are connected to certain taps on the main auto-transformer. In shifting from one running point to another, the lower tap (No. 1) would be opened and connection would be made at a tap four points higher (No. V.). The successive changes are clearly shown in Fig. 5. There are a total of six running points with alternating current; at no time is the motor circuit opened or a transformer winding short-circuited. The current fluctuations are well limited and the acceleration is extremely smooth.

The various switches indicated in Fig. 4, and all of the switches in the circuits of the propelling motors, and of the auxiliary equipment are operated by air under a pressure of 80 lbs. per sq. in., the supply of which to the switch valves is controlled by electromagnets which receive current from a 20-volt storage battery. The switches are arranged in groups that are conveniently located along each side of the center aisle of the locomotive. The groups on one side belong to one motor unit and those on the other side to the other unit. Moreover, the main auto-transformer, the three preventive coils, and the four resistance units for each motor unit are placed on the side of the locomotive devoted to that particular unit. There are two independent sets of storage batteries, each consisting of 10 cells, rated at 40-ampere hours. The batteries are charged by an induction motor-driven direct-current generator.

UNIT-SWITCH GROUP.

A unit-switch group is shown in Fig. 6. Each unit switch, of which there are 11 in the group illustrated, is of the electro-pneumatic type, with which our readers are familiar. An interesting feature is found in the means employed for "interlocking." The switches are interlocked electrically in such a manner that when one switch is closed the circuits to the electromagnets of the other switches which should not be operated are either held open or kept closed, as the case may require, by means of contacts controlled by the piston of the switch valve. These contacts are shown in Fig. 6. All of the motor circuits and switch wires are run in metal conduit along the lower portion of the locomotive, while all of the low-potential battery control circuits are arranged in metal conduit along the roof of the locomotive.

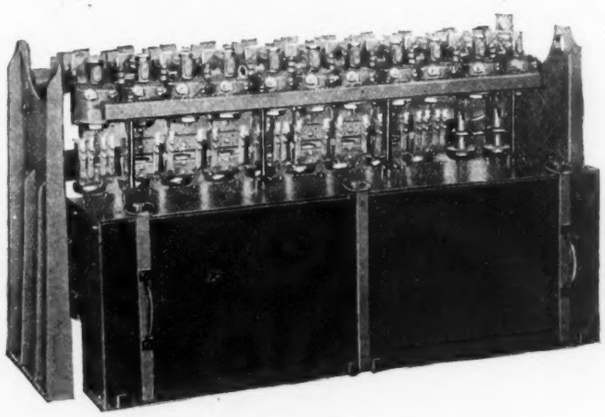


FIG. 6.—UNIT SWITCH GROUP.

As intimated above, only the wires of the battery and electromagnet circuits pass into the controllers. These same wires are run overhead from each end of the locomotive, where they terminate in three contact plugs, taps being taken to each controller and to each unit switch along the route as desired. Thus the locomotive may be operated from either end, and two or more locomotives may be electrically interconnected through "jumpers" and controlled from a single point.

Fig. 7 gives a top view of a master controller, of which there are two on each locomotive. The controller is of the drum type, the drum shaft being revolvable by means of a handle closely resembling the throttle lever of a steam locomotive. The reverse lever, which is detachable, is mechanically interlocked with the operating lever of the controller, so

FIG. 7.—TOP OF MASTER CONTROLLER.

that all control circuits must be dead before the reverse lever is thrown from one position to another, and the main lever cannot be moved when the reverse lever is in the neutral position. The row of knobs seen along the rear of the top of the controller are push buttons for performing certain duties not associated with the main controller lever or reverse handle, such as pulling the alternating-current trolleys down, pushing the direct-current trolley up, releasing the hooks which hold the alternating-current trolley down and the third-rail shoes up, pushing the third-rail shoes down, resetting the main line circuit breakers, operating the front and rear track sanders and ringing the bell. All of the above-mentioned duties are actually performed by compressed air, the eight push buttons serving merely to complete the circuit from the storage battery to the proper air valve magnets.

A front view of the master controller in place in the motorman's corner of the locomotive is given in Fig. 9. For the convenience of the motorman the electromagnets for operating the bell and the front and rear track sanders can be controlled by three pedals in addition to three push buttons. The motorman has an unobstructed view of the air-pressure gauges, a speed indicator, a direct-current ammeter, an alternating-current ammeter, and an electrical pyrometer. The pyrometer, which indicates the temperature of the propelling motors, has been described. The speed indicator is an instrument which registers the voltage produced by a magneto-generator driven by one of the locomotive wheels; it is calibrated to show the locomotive speed in miles per hour. For the purpose of preventing the condensation of moisture on the under side of the steel roof of the locomotive the surface is covered with ground cork, which is then given a coat of white paint.

ARRANGEMENT OF APPARATUS ON THE LOCOMOTIVE.

Fig. 8 shows two views of the interior arrangement of the apparatus on each side of the locomotive, as seen from the center aisle in each case, and indicates that, with the exception of such devices as are not in duplicate, the equipment on each

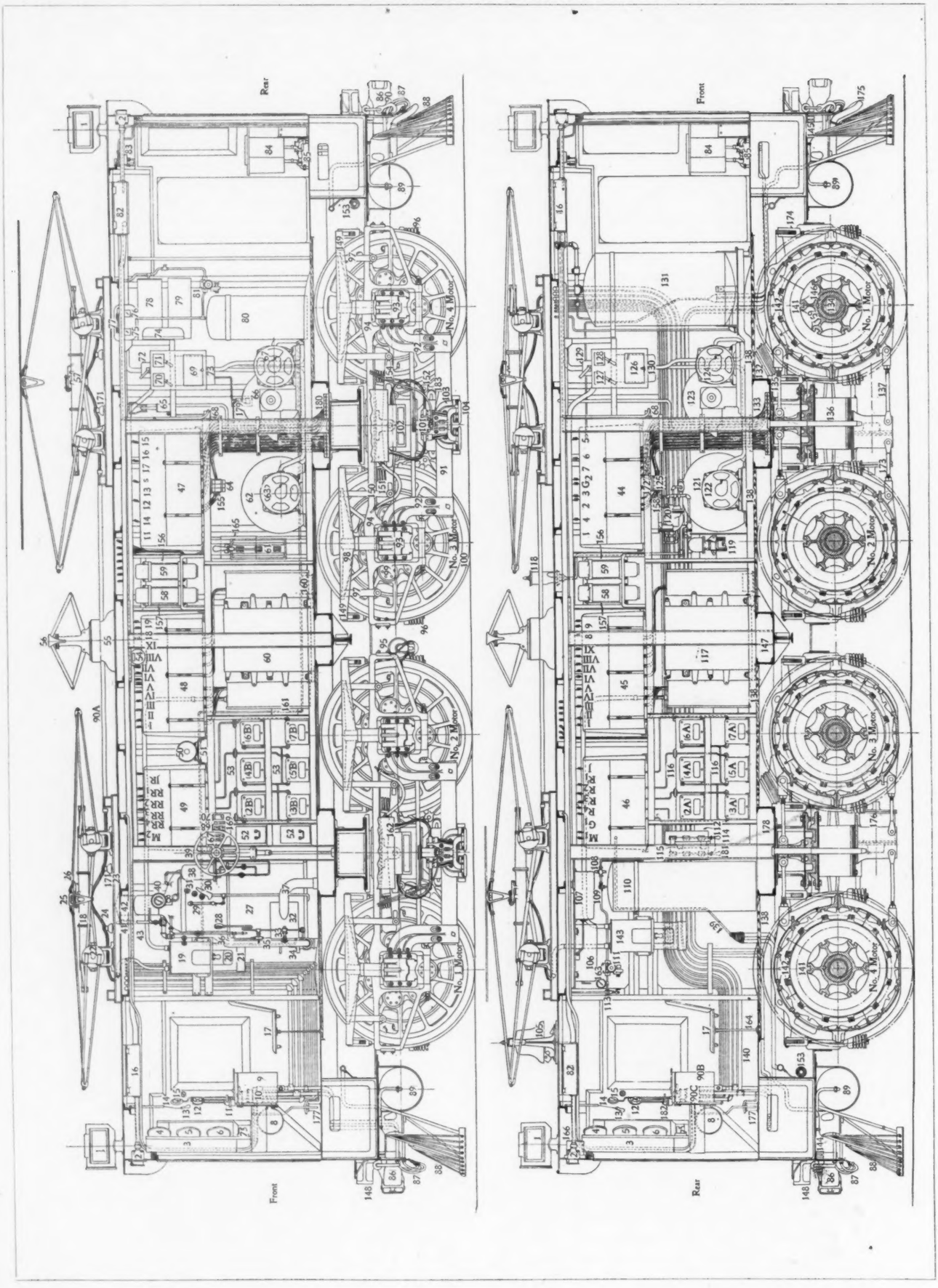


FIG. 8.—VIEWS OF LOCOMOTIVE AS SEEN FROM THE CENTER SHOWING SYMMETRICAL ARRANGEMENT OF APPARATUS.

locomotive is so placed that interior view is the same from one end or side of the locomotive as from the other. Thus the weight is uniformly distributed over the drivers. The different devices, as designated by the numerals, are as follows: 1, headlamp; 2, train line receptacles; 3, instrument board; 4, speed indicator meter; 5, direct-current ammeter, motors; 6 alternating-current ammeter, motors; 7, temperature indicator meter; 8, equalizing reservoir, air brake; 9, No. 1 master controller; 10, No. 1 automatic motorman's brake valve; 11, No. 1 independent brake valve; 12, duplex gauge main res. and train line; 13, whistle handle; 14, straight air brake gauge; 15, 3-way snap switch in lamp circuit; 16, No. 1 junction box; 17, motorman's seat; 18, No. 1 alternating-current pantagraph trolley; 19, No. 2 oil circuit-breaker; 20, overload trip; 21, oil tank on circuit breaker; 22, insulators for pantagraph trolley; 23, support for alternating-current trolley; 24, high-tension cable from alternating-current trolleys; 25, alternating-current trolley shoe; 26, alternating-current trolley lock cylinder; 27, steam heating boiler; 28, gauge—air pressure on burner; 29, water gauge; 30,

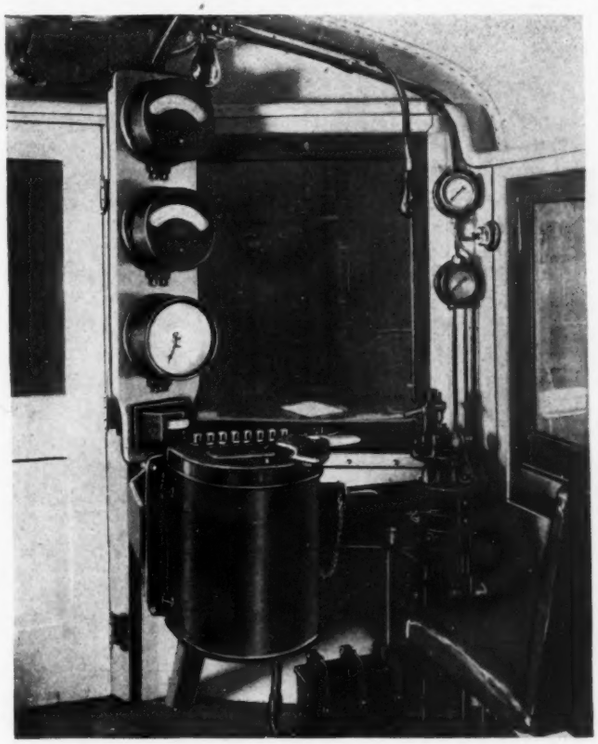


FIG. 9.—MOTORMAN'S CORNER OF THE LOCOMOTIVE.

drain cup; 31, try cocks; 32, fire door; 33, burner; 34, Gold Car Company regulating valve; 35, Mason regulating valve; 36, steam line from boiler; 37, air inlet to fire box; 38, water feed regulator; 39, hand brake wheel; 40, steam gauge; 41, safety valve; 42, stack for boiler; 43, high-tension conduit from oil switch to transformer; 44, switch group No. 1; 45, switch group No. 2; 46, switch group No. 3; 47, switch group No. 4; 48, switch group No. 5; 49, switch group No. 6; 50, motor generator set for battery charging; 51, base for motor generator set; 52, storage battery; 53, No. 2 set of resistance grids; 54, alternating-current watt-hour meter; 55, base of direct-current trolley; 56, direct-current trolley; 57, No. 2 alternating- current pantagraph trolley; 58, preventive coil, 100 volts, 250 amperes; 59, preventive coil, 50 volts, 500 amperes; 60, No. 2 transformer; 61, main direct-current switch; 62, No. 2 blower motor fan casing; 63, No. 2 blower motor; 64, permanent direct-current field coil shunting grid No. 2; 65, hand air pump for unlocking alternating-current trolley; 66, No. 2 air compressor; 67, No. 2 air compressor motor; 68, magnet valves, type 386-D; 69, No. 2 fuse box; 70, canopy switch for No. 2 blower motor; 71, canopy switch for No. 2 compressor motor; 72, No. 2 motor control cut-out; 73, No. 2 alternating-current, direct-current change-over switch; 74, relay box; 75, snap switch for cab lights; 76, snap switch for head lights; 77, single-phase, double-throw switch light circuit; 78, control reservoir; 79, cover for resistance grid; 80, oil tank; 81, slide valve, reducing valve; 82, No. 2 junction box; 83, signal valve; 84, sand box; 85, electro pneumatic sander; 86, coupler; 87, hose couplings; 88, pilot; 89, main air reservoir; 90, hook for safety chains; 90-A, cable connecting alternating-current trolleys; 90-B, No. 2 master controller; 90-C, No. 2 automatic brake valve; 91, third rail shoe beams; 92, third rail shoe bracket; 93, journal box; 94, truck frames; 95, magneto for speed indicator; 96, motor suspension springs; 97, spring hanger; 98, elliptical springs; 99, wheel pocket cover; 100, main driving wheel; 101, third rail shoe cylinder; 102, third rail shoe fuse box; 103, main casting for third rail shoe; 104, third rail shoe.

In the lower half of Fig. 8, will be noted the following additional devices: 105, bell; 106, alternating-current, direct-current change-over switch, heater circuit; 107, fuse box, heater circuit; 108, governor valve for emergency control reservoir; 109, three-way cock emergency control reservoir; 110, emergency control reservoir; 111, slide valve, reducing valve; 112, balancing transformer (back of single-throw and double-throw switches); 113, combined strainer and drain cup; 114, double-throw switch, No. 1, heater circuit; 115, single-throw switch, heater circuit; 116, No. 1 set resistance grids; 117, No. 1 transformer; 118, whistle; 119, governor—air brake; 120, distributing valve; 121, No. 1 blower motor fan casing; 122, No. 1 blower motor; 123, No. 1 air compressor; 124, No. 1 air compressor motor; 125, permanent direct-current field coil shunting grid No. 1; 126, No. 1 fuse box; 127, canopy switch for No. 1 blower motor; 128, canopy switch for No. 1 compressor motor; 129, No. 1 motor control cut-out; 130, No. 1 alternating-current, direct-current change-over switch; 131, water tank; 132, air connection to motors; 133, motor leads for No. 1 and No. 2 motors; 134, axle of main driving wheels; 135, upper torque rod; 136, center pin; 137, lower torque rod (long); 138, trap doors over motors; 139, heater circuit leads; 140, air brake piping; 141, motor armature; 142, motor field core frame; 143, No. 1 oil circuit-breaker; 144, bus line socket heater circuit No. 2 end; 145, bus line rocket heater circuit No. 1 end; 146, quill; 147, tool box; 148, bumper block; 149, motor suspension cradle; 150, spring hanger; 151, equalizer spring; 152, brake shoe; 153, steam heating line; 154, equalizer bar; 155, series transformer for alternating-current ammeter No. 3 and No. 4 motors; 156, preventive coil 100 volts, 250 amperes (back of No. 59); 157, field shunting resistance (back of No. 58); 158, series transformer for alternating-current ammeter No. 1 and No. 2 motors; 159, armature spider; 160, air inlet to transformer; 161, air inlet to resistance grids; 162, third rail shoe leads; 163, gauge—control line pressure; 164, support for motorman's seat; 165, direct-current wattmeter; 166, blind lights; 167, double-phase, double-throw switch for battery; 168, double-phase, double-throw switch for battery; 169, single-phase, single-throw switch for motor generator set; 170, snap switch for motor generator set; 171, insulators supporting alternating-current trolley cable; 172, shunt for direct-current ammeter motors, No. 1 and No. 2; 173, lower torque rod (short); 174, motor suspension hanger; 175, steam hose coupling; 176, brake cylinder; 177, foot push button switches; 178, air circuit; 179, shunt for direct-current ammeter motors No. 3 and No. 4; 180, motor leads for No. 3 and No. 4 motors; 181, double-throw switch, No. 2 heater circuit; 182, independent brake valve No. 2; 183, third rail shoe unlock cylinder.

CURRENT COLLECTORS.

Fig. 1 is an exterior view of a locomotive with the alternating-pantagraph trolleys in contact with the wire; the third-rail shoes are drawn up, as shown more clearly in Fig. 11. The appearance of the third-rail shoes when in the operative position is indicated in Fig. 10. The small trolley seen over the center of the locomotive in Fig. 1 is connected to the circuits of the third-rail shoes and is intended for use only in case the locomotive should come to rest at some point where

the third rail had been omitted and an overhead conductor had been substituted therefor. The contact bows of the large trolley, which are made of galvanized steel, are 4 ft. in length. Each bow is given an upward curvature at the center and is provided throughout its whole length with a single trough for containing the lubricating material which consists of a mixture of graphite and grease.

The design of the third-rail shoe mechanism represents a solution of a number of difficult problems. The shoes must be held by spring pressure downward against an over-running rail, or by spring pressure upward against an under-running rail. They must be lifted so as to clear any ordinary obstruction along the track when a third rail is not used. The shoes are hinged from a framework, which, in turn, is hinged from the base plate of the device. The shoe framework may be

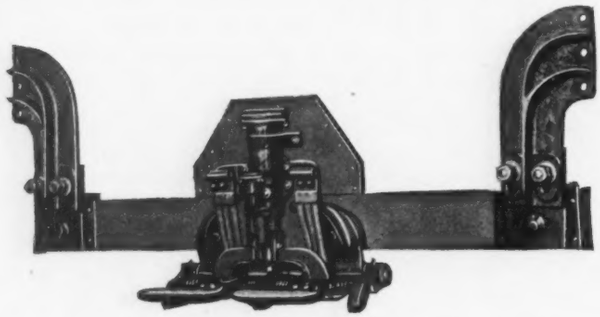


FIG. 10.—THIRD-RAIL SHOES IN THE OPERATIVE POSITION.

thrown outward in a horizontal plane, or drawn upward to an angle of about 45 degs. from the horizontal by means of a toggle-joint mechanism, which is operated electropneumatically. When the framework is in the horizontal position, each shoe is held in place by means of a spring, which resists motion in either the upward or the downward direction. The valve-control circuits of the magnets for the shoe mechanism are electrically "interlocked" with those of the alternating-current trolleys, so that when the trolleys are up, the shoes are up also, and when the shoes are let down, the trolleys come down also; the trolleys can, however, be pulled down while the shoes are up. It is noteworthy in this connection that the "interlocking"

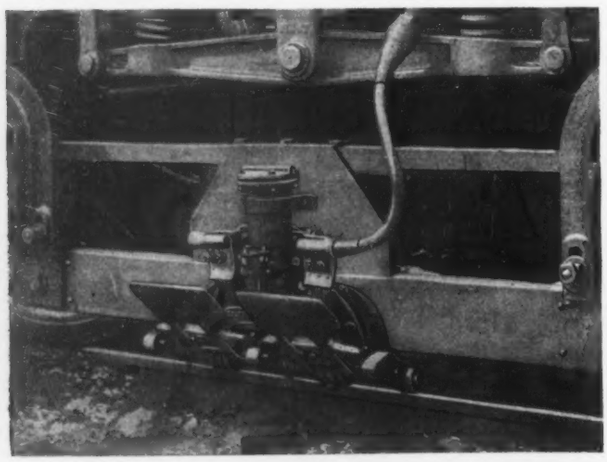


FIG. 11.—DETAILS OF THE SHOE MECHANISM.

is not depended upon for safety to the motor equipment and control circuits. As a matter of fact, it is a physical impossibility for direct current to reach the motors from the third rail while alternating current exists in the auto-transformers, because the "throw-over switch" either connects the motor circuit directly to the third rail and disconnects them from the high-tension circuits, or it joins the motor circuits to the auto-transformers and thoroughly isolates them from the third-rail shoes.

PERFORMANCE OF LOCOMOTIVES.

Although the locomotives have as yet not been placed in actual continuous service on the New Haven Railroad, they have been subjected to tests duplicating in many ways actual service conditions. The track upon which the tests were made is equipped both with a third rail for the supply of direct current at 600 volts, and with an overhead catenary trolley wire for alternating current at 11,000 volts. The track is 2.2 miles in length, and contains several curves and slight grades. During a recent series of tests a locomotive was required to make a schedule speed of 26 m. p. h. with 45-second stops at each end, the maximum speed reaching 45 m. p. h.; the total weight of train and locomotive being 294 tons. Watt-hour meters placed in the supply leads read at three-hour intervals showed that during direct-current operation the consumption was 44 watt-hours per ton-mile, and that the consumption for alternating current working was 42.5 watt-hours per ton-mile. The values given represent the total energy received by the locomotive, including all losses in the control apparatus. Although the running efficiency was undoubtedly somewhat less for alternating than for direct current, the rheostatic losses during acceleration with direct current were much greater than the transformer losses during alternating-current acceleration, and hence the locomotive was operated more efficiently with alternating than with direct current. It is evident, however, that for longer hauls with less frequent stops, the advantage with respect to the efficiency of the locomotive as a unit would be with the direct-current working.

Circular Current Loci of the Synchronous Motor.

By A. S. McAllister.

ALTHOUGH the characteristics of the synchronous motor have been familiar to electrical engineers even longer than have those of the induction motor, yet considerably more has been written concerning the performance of the latter machines than of the former. Doubtless a large portion of the difference in the attentions paid to these two types of machines is due to the relatively greater commercial importance of the induction motor, but at least a small part of the difference may be attributed to the fact that the polyphase induction motor possesses characteristics similar to those of a constant-potential stationary transformer and of a shunt-wound, direct-current motor, and its performance can easily be explained by analogy to persons familiar with these two types of electrical apparatus, while the characteristics of the synchronous motor are essentially different from those of any other machine. On account of its constant-speed features the synchronous motor is becoming of increasing importance for frequency converter work, while its control of the wattless component of the current taken by it from the supply system will probably lead to its frequent use hereafter as a "synchronous condenser."

In view of the facts just stated, it is believed that a description of certain simple circular current loci of the synchronous motor which allow its characteristics to be determined equally as readily as does the circular current locus of the induction motor, will prove of interest at the present time.

Several articles on this same subject have recently appeared in technical publications. The writer wishes to call attention especially to two, namely, one by Prof. Morgan Brooks in the June, 1907, issue of the *Transactions* of the American Institute of Electrical Engineers, and one by Prof. H. H. Norris, in the issue of the *Sibley Journal* for June, 1907.

The article by Prof. Brooks, treats the synchronous motor as an alternating-current generator having a negative load, as is done below; the treatment differs from the present one in that the circle diagrams deal with the internal counter voltage of the motor, rather than with the current taken by the motor. The article by Prof. Norris gives an excellent circular current locus of the synchronous motor, but the arrangement employed,

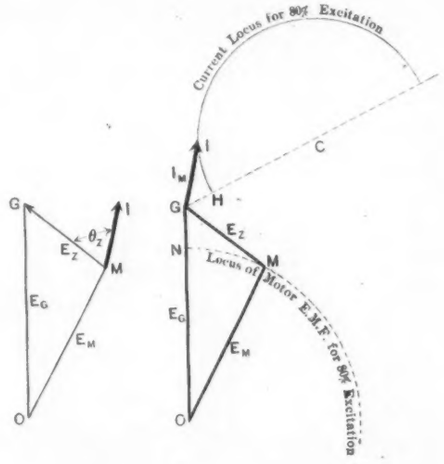
being based on the "opposition" method of representing the vectors of the supply voltage and the internal counter e. m. f. of the synchronous motor, renders necessary the construction of an entirely new set of vectors and a new locus for each valve of the excitation of the synchronous machine.

It is believed that the method outlined below combines the advantageous features of the two methods mentioned above, and eliminates all unnecessary complexity. Moreover, the current loci being similar in many respects to the well-known "circle diagram" of the induction motor allow the characteristics of this machine and those of the synchronous motor to be directly compared with entire simplicity.

For the purpose of most readily developing the current loci used below, consider first the simple familiar case of two alternating-current generators of equal rating and exactly similar in all respects. Assume these two machines to be electrically connected in parallel and mechanically driven by two similar and equal prime movers. The active voltage of each machine will at each instant be equal to that of the other machine; the two alternators will supply equal amounts of power to the external circuit, and there will be no cross-flow of current between the two machines. If the exciting current of one machine is increased while that of the other is unchanged and no change is made in the adjustment of the driving engines, then a certain amount of cross-current will exist between the machines, but they will continue to supply equal amounts of power to the external circuit. That is to say, the power component of the current of each machine will be equal to that of the other; there will exist, however, a certain component of wattless current which traverses only the local circuits including the two generators. The latter current lags 90 electrical time-degrees behind the e. m. f. of the over-excited generator and leads the e. m. f. of the other generator by 90 electrical time-degrees. Thus it tends to demagnetize the field of the former generator and to increase the field magnetism of the latter. Stable conditions are reached when the decrease in the generated e. m. f. of the former and the increase in the generated e. m. f. of the latter alternator are such that the difference between the two is just sufficient to force through the local impedance of the two armatures and their inter-connecting circuits that amount of current required to produce the necessary change in the field strength of the two machines. It is seen, therefore, that the value of the cross-current for a certain change in exciting current depends upon the ratio of the number of turns in the field coils to the number of turns on the armatures, and upon the local impedance of the armature circuits; that is to say, it depends upon "armature reaction," armature resistance and local magnetic reactance of the armature. The "armature reaction" refers exclusively to the effect of the armature current upon the field magnetism. The change in the generated e. m. f. is roughly proportional to the cross-current, so that the armature reaction may, with a fair degree of accuracy, be expressed in ohms as the quotient of the change in the generated volts divided by the cross-amperes. Although the results obtained are not strictly in accord with facts, it is customary to consider that the armature reaction in ohms can be treated as an addition to the ohms of "local magnetic reactance" of the armature circuit, the sum of the two being designated as the "synchronous reactance" of the armature circuit. The quadrature vector sum of the synchronous reactance and the resistance of the armature is known as the "synchronous impedance" of the armature circuit, designated herein as Z_m. It should be carefully noted that the synchronous impedance is a fictitious, composite quantity. It has no real existence; of its three components, only one, namely the armature resistance, is constant; both the local magnetic reactance and the armature reaction depend upon the electrical space position of the armature at the instant when the armature current reaches its maximum.

Referring again to the two similar alternators in parallel, assume that, with the field strengths of the two alternators adjusted to equality, the supply of steam to one engine is gradually decreased. The alternator driven by this engine will tend to decrease its speed, but it continues to operate at the same number of revolutions per minute as the other alternator. What actually does occur is that it lags behind the other alternator in electrical space position, such that its generated e. m. f. is out of phase in electrical time-degrees from the generated e. m. f. of the other alternator such that the vector difference between them forces through the "synchronous impedance" of the two armatures and their interconnecting circuits an amount of current such that its vector product with the e. m. f. of each alternator represents the power transferred to or from this alternator from or to the other machine. It will be noted, therefore, that the gradual conversion of an alternator from a synchronous generator to a synchronous motor, electrically considered, is accompanied by a mere change in the electrical time-phase position of its e. m. f. with respect to the e. m. f. of the system to which it is connected.

The vector representation of the phenomena of synchronous motors is rendered extremely simple when such representation is based on the well-known facts discussed above. In Fig. 1, $O\ G$ is the e. m. f. of the supply system, E_g; $O\ M$ is the e. m. f. of the synchronous motor E_m; $G\ M$ is the "resultant" e. m. f. E_z which produces the current $M\ I$ in the synchronous impedance of the motor circuits Z_m. The angle $G\ M\ I$, Θ_z, is that angle whose cosine is equal to the quotient of the armature resistance divided by the synchronous impedance of the motor; for simplicity this angle will hereafter be considered constant. The vector product of $O\ G$ and $I\ M$ is the electrical power received from the supply system while the vector product of $O\ M$ and $I\ M$ is the mechanical power delivered to the motor shaft, including magnetic and frictional losses; the difference between these two (equal numerically to the vector product of $G\ M$ and $I\ M$) is the power absorbed thermally in the armature resistance. The value of $I\ M$ depends solely upon the value of $G\ M$: $O\ G$ varies directly with the e. m. f. of the supply system, while $O\ M$ depends solely upon the field strength of the motor.



FIGS. 1 AND 2.—VECTOR DIAGRAM OF CURRENT AND E. M. F.'S OF SYNCHRONOUS MOTOR, AND CIRCULAR LOCI OF ARMATURE CURRENT AND MOTOR COUNTER E. M. F.

Assuming a certain constant value for $O\ G$ and assigning a value to $O\ M$, it will be noted that the locus of the point M as the load is varied is the arc of a circle whose center is at the point O. For convenience the vector of the current may be plotted from the point G, as shown in Fig. 2; this construction is particularly advantageous in that it permits of the direct representation of the time-phase relation of the two quantities that are most easily measurable, namely, the e. m. f. of the supply system and the armature current. The locus of the point I as the load is varied is the arc of a circle whose center is on a line between which and the line $O\ G$ (prolonged) there is an angle Θ_z (whose cosine is equal to the quotient of

the armature resistance by the synchronous impedance). The exact location of the center of the circular arc, for a certain definite synchronous impedance depends solely upon the e. m. f. of the supply system. That is to say, the value GC is found by dividing the e. m. f. of the supply E_g by the synchronous impedance of the motor Z_m. The radius of the circle is determined solely by the field strength of the motor, or more properly, by the internal counter generated e. m. f. of the motor E_m. Thus the length CH is equal to the motor e. m. f. E_m divided by the synchronous impendance of the motor, Z_m.

Since CH is proportional to OM, it will be noted that the diagram may be simplified and rendered more convenient without loss of accuracy by omitting OM entirely and allowing CH to represent its relative value (but not its time-phase position). Application of the above considerations leads to the simplified diagram of Fig. 3, which is the complete operating current and e. m. f. diagram of a synchronous motor.

In the diagram of Fig. 3 OG is the e. m. f. of the supply, and OI is the current taken by the motor, in both its true value and time-phase position with reference to the supply e. m. f. The distance OC is equal (in amperes) to the value obtained by dividing the supply e. m. f. E_g by the synchronous impedance of the motor Z_m. The angle GOC ($=\theta_z$) is such that its cosine is equal to the quotient of the resistance of the armature by the synchronous impedance. It will be seen therefore that the line OC represents both in value

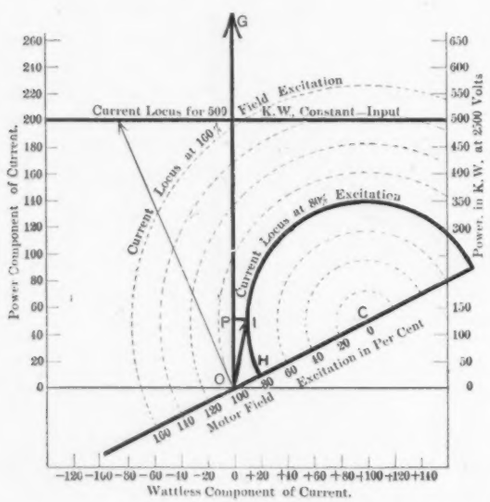


FIG. 3.—CIRCULAR CURRENT LOCI FOR VARIOUS MOTOR EXCITATIONS.

and time-phase position the current taken by the armature when subjected to the full supply e. m. f., but without any counter e. m. f. The line CH has the same significance as in Fig. 2, being the value (in amperes) obtained by dividing the counter e. m. f. of the motor E_m by the synchronous impedance Z_m. When the motor e. m. f. E_m is equal to the supply e. m. f. E_g CH becomes equal to OC; under any condition of excitation CH bears to OC the ratio of the motor e. m. f. E_m to the supply e. m. f., E_g.

Referring now to any point I on the heavy circular arc of Fig. 3.

OI is the input current to the motor

OP is the power component of the current

$\frac{OP}{OI}$ is the power factor, $= \cos\theta$

$OP \times OG = I_m \cos\theta\, E_g =$ input watts

$I_m E_g \cos\theta$ — losses = output watts

$\frac{\text{Output watts}}{\text{Input watts}} =$ efficiency

$OC =$ "short circuit" current (at full speed, without excitation)

$\frac{CH}{OC} = \frac{\text{motor e. m. f.}}{\text{supply e. m. f.}} =$ percentage excitation

$OH =$ minimum possible armature current.

In Fig. 3 the heavy circular arc shows a single current locus for a definite field excitation of the motor. Referring to Fig. 1, it will be recalled that the radius of the circular locus of the point M of the motor e. m. f. vector depends solely upon the field excitation of the motor. Hence the radius of the circular locus to the point I of the current vector in Figs. 2 and 3 likewise depends solely upon the field excitation of the motor. Thus for each value of field excitation there is a definite circular current locus, the center of which remains always at the point C (in Fig. 2 or Fig. 3). The current locus passes through the point O when the field excitation of the motor is such that the counter e. m. f. E_m is equal to the e. m. f. of the supply E_g. For convenience this value of motor field excitation may be designated as 100 per cent, and other values may be compared therewith on the percentage basis. Thus for the current locus represented by the heavy circular arc in Fig. 3 the motor excitation is 80 per cent (HC being equal to .80 OC). Other circular current loci for various excitations are shown by broken lines.

It is to be noted especially that the above discussion of the circular current loci of Fig. 3 relates exclusively to the input to the synchronous motor. For any chosen value of input the corresponding output can be obtained by calculation when the losses are known. The problem of determining the friction and the hysteresis and eddy current losses of the armature and the field circuit copper loss can be solved only when accurate information is obtainable concerning the construction of the machine and the exact conditions under which it is operated. The determination of the copper loss of the armature is, however, a comparatively simple matter. As the latter loss varies with the square of the current, quite independent of its time-phase position, it is convenient to plot for each value of current the corresponding loss directly to the same scale and on the same diagram as used for plotting the input power. The scales chosen in Fig. 3 and the subsequent diagrams have been based on a constant supply e. m. f. of 2500 volts, an armature circuit resistance of $R_m = 10$ ohms and a magnetic reactance of $X_m = 20$ ohms. Thus the impedance of the armature circuit $Z_m = \sqrt{R_m^2 + X_m^2} = 22.36$ ohms and the short-circuit current (the length OC in Fig. 3) is 2500 volts $\div$ 22.36 ohms $= 111.8$ amperes. The angle GOC has a cosine ($\cos\theta_z = \frac{R_m}{Z_m}$) of .4472.

The loss for each value of current can conveniently be found as follows: Referring to Fig. 4 select any value of current, such as OI, taken here as 80 amperes; the loss occasioned by this current in a resistance of 10 ohms is $10\,(80)^2 = 64{,}000$ watts, or 64 kilowatts. From the point M (at 80 amperes) erect the perpendicular MN equal to 64 kilowatts (to the scale corresponding to the supply e. m. f. of 2500 volts). Quite independent of its time-phase position, a current of 80 amperes causes a loss of 64 kilowatts in the armature circuit. At a certain definite phase position, such that the power component of the current is just equal to the value corresponding to 64 kilowatts (25.6 amperes at 2500 volts), all of the power received by the synchronous motor is dissipated thermally in the resistance of the armature circuit; this position is found at the point P, where a horizontal line from N intersects the 80-ampere current arc IPM. Consider now a current of 140 amperes; the armatureloss is $10\,(140)^2 = 196{,}000$ watts—plotted as 196 kilowatts at $M'N'$. The point P', at the intersection of the 140 ampere current arc and the horizontal line from N' shows the position of the extremity of the 140-ampere current vector when the power input is just equal to the loss in the resistance of the armature circuit. A sufficient number of points having been located by the method used with points P and P' and a curve being drawn through these points, there is obtained the current locus OPP' for "zero mechanical power" meaning

that value of input power that is just equal to the power dissipated thermally in the resistance of the armature circuit. From the method employed in its location, it may be shown that this locus is a true circle which passes through the point *C*—the "zero excitation" point—and has its center on the e. m. f. vector *OG*. It will be noted therefore that the locus for "zero mechanical power" is known immediately when the point *C* is located. It is interesting in this connection to note that the diameter of the "zero mechanical power locus" expressed in amperes (the maximum current which the machine can possibly obtain from the supply system and just overcome its own armature copper loss) is equal to the quotient of the supply

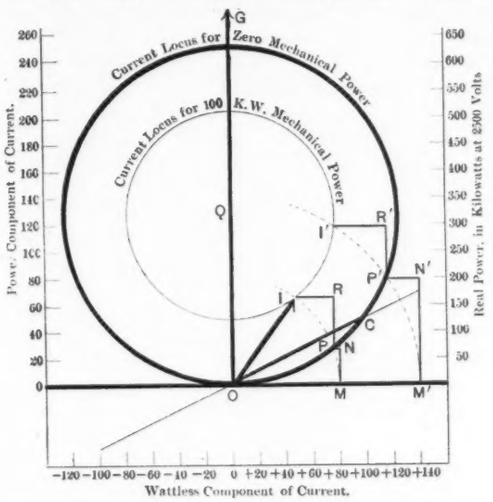


FIG. 4.—CIRCULAR CURRENT LOCI FOR VARIOUS MECHANICAL LOADS.

e. m. f. divided by the resistance of the armature circuit; it is greater than the "short-circuit" current at zero motor excitation in the ratio of the synchronous impedance to the armature resistance. These statements need no proof, for they will be appreciated at once from a study of Fig. 4.

By the use of the "current locus for zero mechanical power" one can readily determine the effective mechanical power delivered to the shaft of the synchronous motor. In Fig. 4 assume that with an armature current of 80 amperes the power input is 164 kilowatts; the armature copper loss is 64 kilowatts (*MN*), hence the mechanical power at the shaft is 100 kilowatts (*RP*). By the method outlined above the point *I* of the "current locus for 100 kilowatts mechanical power" is located at the intersection of the horizontal line *RI* with the 80-ampere circular arc, *MPI*. With an armature current of 140 amperes, the input must be 296 kilowatts to supply mechanical power of 100 kilowatts. A second point *I'* on the "current locus for 100 kilowatts mechanical power" is found at the intersection of the horizontal line *R'I'* (corresponding to 296 kilowatts input) and the 140-ampere circular arc *M'P'I'*. A curve drawn through points located as have been *I* and *I'* gives the complete "current locus for 100 kilowatts of mechanical power" delivered to the armature shaft—including all losses except that of the armature copper. It may be shown from the method used in its construction that this locus is a true circle concentric with the circular "current locus for zero mechanical power," therefore the locus for any possible value of mechanical power is known at once when one point, such as *I*, is located on its circumference. The locus for the maximum mechanical power which the machine can deliver to its own shaft is a circle, contracted to a point, at *Q*. This power is delivered at a power factor of 100 per cent and an electrical efficiency of 50 per cent; the current corresponding thereto is equal to the quotient of the supply e. m. f. divided by twice the resistance of the armature circuit. These facts are well illustrated in Fig. 4.

A comparison of Fig. 4 and Fig. 3 will show that both when the excitation is left constant and the load is changed, and when the load is left constant and the excitation is changed, the locus of the armature current is a true circle; in the former case the circle has its center at the point of zero excitation, while in the latter the center is at the point of maximum load. By finding the intersections of various constant-input circles with certain constant-load circles, one may readily determine the ordinates and abscissae for the familiar so-called "V-curves," showing the relation between the armature current and the excitation of a synchronous motor at various loads. Such a set of V-curves and a convenient method for determining the points on the curves are shown in Fig. 5. The ordinate *HI* of the V-curve for a load of 100 kilowatts at an excitation of 3500 volts is equal in length to the vector *OI*, whose extremity lies at the intersection of the 100-kilowatt current locus with the 140-per cent excitation current locus; there are two points of intersection of these two loci, so that there are two abscissae for each ordinate on the V-curves. Moreover, there are two ordinates for each abscissa, both the V curves and the current loci being closed curves. The ordinate *H'I'* at an excitation of 2500 volts is equal in length to the vector *OI'* of the 100-per

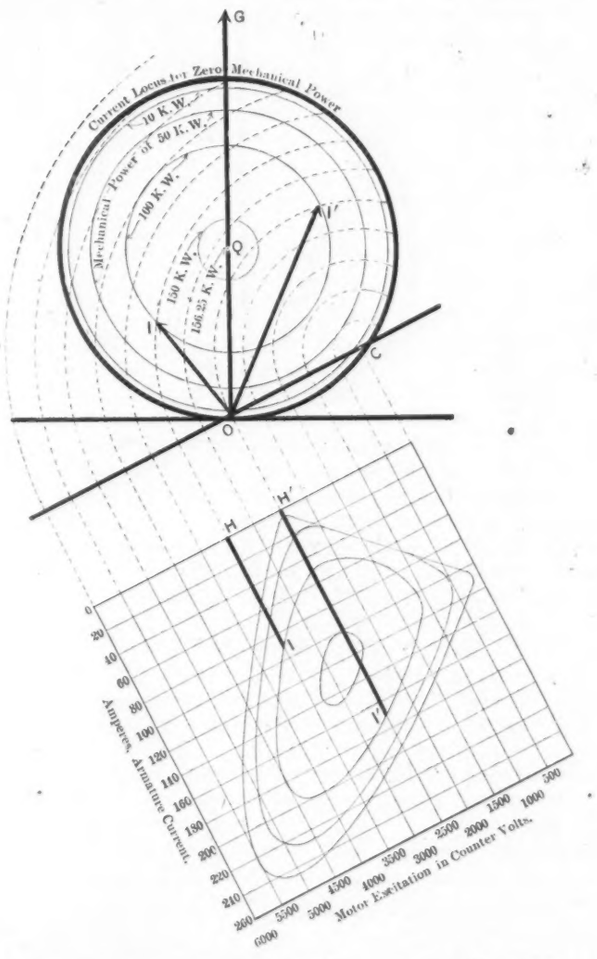


FIG. 5.—CIRCULAR CURRENT LOCI, O-CURVES AND V-CURVES.

cent excitation current locus. The construction of the complete set of V-curves should be obvious from the above brief reference to Fig. 5.

By inverting the diagram of Fig. 5 it will be noted that the V-curves are the same in every respect to the set given in Dr. C. P. Steinmetz' "Alternating Current Phenomena*," the constants used in the above synchronous motor problems having been taken directly from that book. As thoroughly discussed by Dr. Steinmetz, the calculation for the V-curves have been based on certain simplifying assumptions that do not correspond accurately to facts in nature. Thus the "synchronous reactance" has been considered as constant while in reality it varies throughout a considerable range; moreover, the change

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in the permeability of the magnetic circuit of the motor has been neglected. Evidently the same simplifying assumptions have been made in the present treatment and the results are subject to the same errors. The results obtained by the present method are identical in every respect to those obtained by the more usual mathematical treatment, within the limits of the errors in measuring lengths on a graphical diagram; the latter errors are much smaller than those attributable to the incorrect initial assumptions. So far as reliable results are concerned the graphical method is equally as good as the analytical, while it possesses the advantage of allowing the reader to follow the solution step by step without losing sight of the involved electro-magnetic phenomena. The circular current loci of Fig. 5 in themselves contain all of the information imparted by the V-curves, and in addition thereto they show the time-phase relation of the supply voltage and the armature current, and they indicate the maximum and minimum limits and the critical points to much better advantage than do the V-curves.

The treatment outlined above has been based on single-phase work and single-phase apparatus. It is almost unnecessary to call attention to the fact that the same treatment without any modification whatsoever is directly applicable to the operation of polyphase apparatus, provided equivalent single-phase values are used for the current, resistance, synchronous reactance and synchronous impedance of the armature and supply circuits.

Self-Excitation of Unipolar Generator.

In the operation of unipolar generators it has been found that the ohmic drop at the brush contacts forms a large part of the full-load voltage drop in the machine. Moreover the brush resistance is somewhat variable and unsteady. When the field winding of the generator is connected across the machine terminals in the usual manner, the ohmic drop at the brush contacts as the load increases results in a decrease in the voltage impressed upon the field terminals, and consequently impairs to a certain extent the regulation of the machine. Prof. Elihu Thomson recently obtained a patent for an arrangement for supplying current to the field winding from auxiliary brushes independent of the armature circuit. With the arrangement proposed the current passing through the brushes supplying the field winding is constant for all loads of the machine and the excitation of the machine is unaffected by the ohmic drop in the armature circuit due to brush contact resistance. The auxiliary brushes are placed on collector rings connected to opposite ends of a single conductor. This conductor is one of the regular conductors connected in the armature circuit, but it is given a somewhat greater cross-section than the other conductors in order to enable it to carry the exciting current without overheating. In some cases a separate conductor is employed for supplying current to the field winding.

New Telephone Patents.

SUBSCRIBER STATION APPARATUS.

Every once in a while a false signal is sent in from a desk telephone due to the receiver being lifted by resting upon some raised object upon the desk. This occurs usually in a way almost unnoticeable. To avoid the trouble, G. L. Blackburn, of Greensboro, N. C., has devised a guard to be clamped to the stem of the stand just below the normal position of the receiver. This guard will protect the receiver from accidental upward pressure.

For party lines, A. H. Beng has planned a signal device to notify calling parties of the number of the stations responding. He links a code bar to the switch lever and arranges a bell to be rung by it mechanically. This bell is enclosed in the set. Each answering party rings in his code on his bell, and this is picked up and transmitted to the line by his transmitter.

There have recently been patented two antiseptic devices of the sheet-of-paper type. G. E. Grim, of Philadelphia, forms up a sheet metal device, comprising two leaves joined together at the top by a cylindrical spring hinge. This latter serves as a roll holder, the paper being led down between the leaves. The leaves are perforated and one carries means for gripping the mouthpiece of the transmitter.

The other device consists of two roll holders and a clamp. This latter grips the mouthpiece and holds the device in such position that a strip of paper stretched from roll to roll will lie across the mouthpiece. A crank and spool serve to wind up the used end of paper into one roll holder from the other.

August Schaffer, of East Columbus, Ohio, has invented what he calls an anti-buzzing device. This is a novelty in the form of a built-up lozenge adapted to be clamped under the cap of a receiver to prevent sympathetic buzzing of the diaphragm. A disk of wire screen with a paper-covered center is surmounted by an annulus upon which lines a concavo-convex disk. The whole is clamped together at the edges and forms a spring cushion.

S. C. Houghton, of Rome, N. Y., has obtained a patent for an improvement for a telephone support described in an earlier patent, and F. B. Cook, of Chicago, has patented a novel substation protector. In this latter, the tubular fuses, heat coils and carbons are all enclosed within a porcelain block. This block has apertures for receiving these parts and the necessary connecting springs, etc.

NEW SWITCHBOARDS.

Usually in the working out of the two-wire common battery switchboard, the successful operation of the signals is obtained with the use of but one battery voltage. Messrs. J. W. Lattig, of West Bethlehem, Pa., and C. L. Goodrum, of Philadelphia, in their joint invention have resorted to the equivalent of three. As a matter of fact, taps from one battery supply these differ-

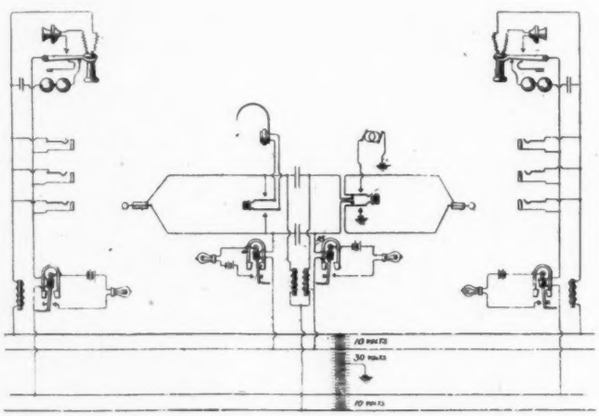


FIG. 1.—LATTIG AND GOODRUM TWO-WIRE MULTIPLE TELEPHONE SYSTEM.

ent currents and the circuits are so designed as shown in Fig. 1 that the current reverses in the polarized signal relays to change the indication of the signals. It will be noted that because of the points of connection of the current supply leads to the buses, when the plug is inserted in a jack the high-power operating current in the line relay becomes a low power reversed current. Similarly the opening of the circuit at the sub-station causes a reversal in the supervisory relays, the non-operating current being the low power one as before.

H. P. Claussen, of Chicago, has invented a circuit arrangement by which the ringing is controlled automatically. The operator starts the ringing, the ringing key becoming locked magnetically until the response. The rising of the subscriber's hook completes the circuit of an auxiliary relay, which through its contacts short-circuits the locking coil. The circuit of the auxiliary relay includes a grounded battery, one side of the

line and a path through the hook switch and bell back to ground.

PARTY-LINE SYSTEMS.

A lockout step-by-step system forms the subject of a patent granted to U. S. Jackson, of Ossipee, N. H. The usual selective apparatus is provided at each station and these may all be moved forward under control of any station, and each angular position corresponds to one station. The instruments at all stations are short-circuited except when wanted. A release lever enables the user to restore the line to zero at the end of a call.

W. D. Watkins, of San José, Cal., has invented the selecting device shown in Fig. 2. It will be seen that a slight teetering of the armature rotates the switch arms, as its pin travels between the bent leaves, each one of which is bent to deflect it in

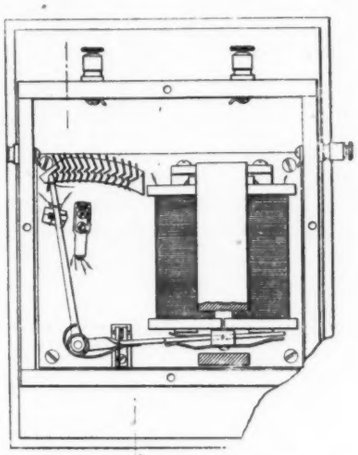


FIG. 2.—WATKINS TELEPHONE SELECTING APPARATUS.

the proper direction. The connecting switches at the various stations are spaced below the leaves as shown. If the arms be depressed at any instant one in the proper position, will operate the switch springs. After the conversation, a further application of current draws the pins below the guide leaves and the arms return to the initial position.

A party-line system invented by D. H. Wilson, of Chicago, contemplates a line with a constantly impressed potential, and one limb of the line looped into each station, and through a relay at each. Bells are normally bridged across the line, but through the contacts of the relays. Whenever a conversation is going on, current flows through all the relays and the bell bridges are all severed, thus relieving the line.

LETTERS TO THE EDITORS.

Graduates from Electrical Courses.

To the Editors of Electrical World:

SIRS:—I have read with interest the article and editorial in your issue of July 27, on "Graduates from Electrical Courses in the United States," and am yielding to a temptation to write a few lines regarding them.

The statement in the editorial that "The technical graduate is ideal raw material from which to recruit every branch of an industry," etc., is certainly well put, and something that cannot be too well kept in mind by those who arrange the work comprised in engineering courses.

When, in the article, the statistics are reached, it is clear that some sort of classification among all the schools offering courses in electrical engineering was necessary and desirable. As I read the articles, however, I am wondering what the one who wrote them means by a "high-grade" course. Does he mean one which takes most time to complete it, or which has highest scholastic requirements for entrance, or which reaches furthest into the realms of theory and pure science, or which includes the greatest amount of what is commonly known as liberal culture work? I do not believe I am far wrong in assuming that some or all of these have been the criteria for the classifications made.

If I have made a fair guess, I can go on to say that there are many wrong ideas of engineering education abroad, especially in reference to the newer courses and those not laid on "standard" lines.

A great many people who write on educational topics in our technical papers are influenced more than they know by preconceived notions. These are partly due to their having had a "standard" course themselves and partly to the fact that they have closest acquaintance with people in engineering education who conduct standard courses. The courses offered by colleges and state universities are, for the most part, at least, so hedged about by other courses, by traditions, and by the fact that the guiding spirits in them have grown up amid ideas handed down from past generations, that the condition of affairs I refer to is most natural.

I have often wondered that some enterprising periodical did not make an investigation of the merit or demerit of various courses now offered which are of a newer and perhaps of a peculiar sort while they profess to be really of engineering character, in order that the truth about their professions might come out.

Is it not a curious thing that the great manufacturing companies who receive and even seek graduates from "high-grade" courses never assume such men to have any practical or laboratory knowledge when they enter their employ? And, from the kind of study facilities they offer them in their apprenticeship period, it would seem that they very greatly discount the theoretical knowledge which such men have received as students.

DREXEL INSTITUTE, PHILADELPHIA. ARTHUR J. ROWLAND.

[We fail to find in the article or editorial any reference to a "high-grade course." The following quotation from the article gives the criterion applied in allotting schools to Class I: "In Class I are included the schools of which the electrical courses enjoy the highest standing, which have the completest equipment for teaching and whose degree confers more or less prestige on the graduate. Naturally, this list includes many of the schools which early established electrical courses."

An investigation of the relative merit of electrical engineering courses now offered by our schools would, without doubt, be of some interest; but such an investigation, to be fair to the faculty, who would have to bear the onus of imperfections brought to light, should take into account the non-educational influences which so largely determine the character of the curricula. In this country, with perhaps a few exceptions, the character of college courses, and particularly of technical courses, is largely influenced by what may be termed commercial considerations. That is, if a "standard" course, even though possessing ideal merit, did not conform with respect to qualifications for admission, to the prevailing public school standard of finished secondary education, or to the views of parents as to the relative money value of theory and practice, customers for the kind of education offered would be few; and a falling off in the number of students entering an institution would, under present conditions, be much more fatal to prestige than a lowering of the value of its course. In short, competition among schools and the necessity of the modern college president making favorable showings as to attendance in order to secure satisfactory legislative appropriations or attract endowments, so largely influence the character of higher educational courses in this country, that a comparison with respect to their real educational value would be of little more than academic interest.

As to the position of manufacturers taking on graduates, to our mind it indicates their opinion of the high value of the "theoretical" training of the graduate and the worthlessness of any "practical" training he receives at school.—EDS.]

Synchronous Motor Compensation for Lagging Currents.

To the Editors of Electrical World:

Sirs:—In my article on "Synchronous Motor Conpensation for Lagging Currents," which was published in your issue for Aug. 10, there appeared certain errors to which I wish to call your attention. The first sentence in the fourth paragraph of the first column on page 283, which ends: "and let *OY* represent to the same scale the magnitude and direction of the armature reactance and the resistance, which is not absolutely to the same scale, the magnitude and direction of the armature impedance drop," should end as follows: "and let *OY* represent to the same scale the magnitude and direction of the armature reactance drop, and then *XY* by its magnitude and direction may be taken to represent the armature impedance drop." The last sentence in the second paragraph of the first column on page 284 should read "the counter e. m. f. of the motor * * * measures approximately 1100 volts," instead of "1200 volts." The sentence in the first paragraph in the second column on page 284 which reads: "The resultant of the total line current will therefore be represented by the vector sum of *X'X'* and *X'X'*," should end as follows: "The vector sum of *XX'* and *X'X*$_1$'."

Wilkinsburg, Pa. Clarence P. Fowler.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Single-Phase Motors.—H. Goerges.—The first part of a paper read before the German Association of Electrical Engineers on the properties of various types of single-phase motors considered from a common point of view. The paper is to be continued.—*Elek. Zeit.*, July 25.

Motor.—E. Danielson.—An illustrated translation of his German article on a combined single-phase and direct-current series and compensated repulsion motor, which has already been described in the Digest.—Lond. *Elec.*, July 26.

Determining the Temperature of an Electric Machine.—F. Loppe.—An article describing a graphical method by means of which it is possible to estimate the final temperature of a machine by plotting the curve of the increase of temperature as a function of the time during the first hours of operation.—*L'Industrie Electrique*, July 25.

Balancing Rapidly-Rotating Machinery.—M. Kroll.—An article illustrated by diagrams on the necessity of balancing the parts of a machine which revolves at a very high speed on account of the forces and torque caused by any lack of balance. He also discusses simple devices for measuring these forces.—*Elek. und Masch.*, July 28.

Direct-Current Dynamo.—F. Loppe.—An elementary article on the calculation of a direct-current dynamo.—*L'Industrie Electrique*, July 10.

Lamps and Lighting.

Efficiency of Lamps.—H. Lux.—A continuation of his illustrated serial. In the present installment he discusses the separation of the visible radiation from the invisible radiation. The only exact method for doing this is to determine the energy of radiation for each single wave length by bolometric methods and then to plot the results in the form of a curve. The part of the curve between the wave lengths 0.4 and 08μ represents the visible radiation. In this way the following values were found for carbon-filament lamps and Nernst lamps:

	Carbon filament.	Nernst lamps.
Ratio of light radiation to total radiation.....	3.5 %	5.7 %
Ratio of light radiation to power consumed.....	2.74%	3.85%
Watts per hefner candle (mean spherical).....	4.09	1.91

The figures show that Wedding's figures are all wrong; the latter had found the value 0.2 per cent for carbon incandescent lamps and 0.8 per cent for Nernst lamps for the ratio of light radiation to consumed energy. The figures in the above table contain an apparent paradox. According to them, in order to produce the same candle-power, the Nernst lamp requires less than one-half the energy of the carbon-filament lamp, while the figures for the ratio of light radiation to consumed energy are 2.74 and 3.85. The explanation is that in determining the candle-power, the physiological effect of the different wave lengths counts, while in measuring the energy of the different wave lengths by bolometric methods the physiological effect is not taken into account. The carbon-filament lamp is much richer in dark red rays than the Nernst lamp. Almost one-half of the total "visible radiation" of the carbon-filament lamps is in the region between 0.72 and 0.8μ, while for the Nernst lamp only one-fifth of the total visible radiation is in this region, in which the waves have a very small physiological effect.—*Zeit. f. Beleucht.*, July 20.

Osram, Tungsten, Zirconium Lamps.—J. T. Morris, F. Stroude and R. M. Ellis.—The first part of a paper on an extended investigation carried out with a number of lamps about which particulars are given in the following table:

Carbon, 5 cp.....	.....
Carbon, 16 cp., C_1.....	**15.5**
Tantalum, 25 cp., T 1.6 watts per horizontal cp.....	.....
Tantalum, 25 cp., T_1 1.83 watts per horizontal cp.....	4.5
Tantalum, 25 cp., T_2 1.94 watts per horizontal cp., 1,850°C.....	4.8
Tantalum, 25 cp., T_3 1.94 watts per horizontal cp., 1, 850°C.....	4.8
Osram, 50 cp., O_3 1.27 watts per horizontal cp.....	3.45
Osram, 32 cp., O_2 1.32 watts per horizontal cp.....	3.75
Osram cp., 50 O_3 1.27 watts per horizontal cp.....	3.45
Osram, 50 cp., O_4 1.23 watts per horizontal cp.....	.....
Osram, 50 cp., O_5 1.23 watts per horizontal cp., 2,000°C.....	.....
Tungsten (Just), 40 cp., W_1 1.29 watts per horizontal cp., 2,000°C..	.....
Tungsten, 40 cp., W_2 1.13 watts per horizontal cp.....	3.45
Zirconium, 35 cp., Z_3 1.35 watts per horizontal cp.....	.....
Zirconium-tungsten, 35 cp., Z_1 1.46 watts per horizontal cp., 2,000°C..	.....
Zirconium-tungsten, Z_2 1.42 watts per horizontal cp.....	3.7

The marks C_1, T, etc., are those used in the following diagrams. The table gives, besides the specific consumption of the lamps, the working temperature of the filament, and in the last column the percentage voltage at which the filament is just visible in the dark. The authors first investigated the effect of voltage variation, the lamps being supplied with direct current. The results are given in Fig. 1. In metallic

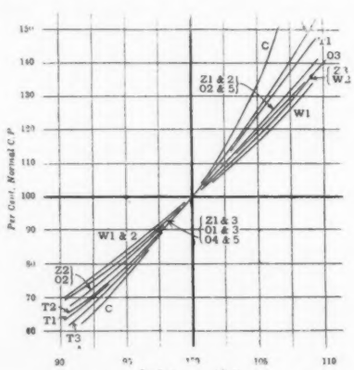


FIG. 1.—VOLTAGE-CANDLE-POWER CURVES.

filament lamps a variation of 1 per cent in voltage produces about 4 per cent change of candle-power, as compared with the 7 per cent change in carbon filament lamp. Fig. 2 shows curves connecting voltage and resistance. These curves were used to determine the theoretical ratio of the starting current to the final current. The same ratio was also determined by means of a Duddell oscillograph. The values obtained by the latter method are always lower than those found from the resistance curves. This is due to the combined effects of the inductance of the circuit and the inertia of the oscillating parts of the oscillograph. It is interesting to note from the oscillo-

graph that after subjecting a metallic-filament lamp to normal voltage, the current remains distinctly above its final value even after two or three minutes have elapsed. Fig. 3 gives curves connecting voltage and watts per candle. To estimate

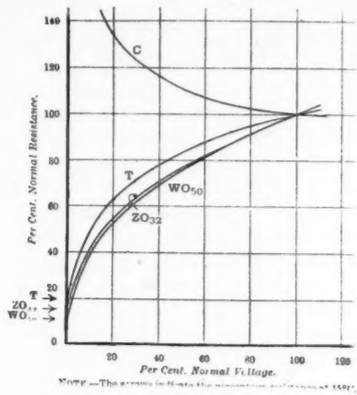


FIG. 2.—VOLTAGE RESISTANCE CURVES.

the temperatures of the filaments the authors determined first the expansion of the filament and also applied Stefan's law. The values found are given in the above table. From the last column in the same table it is seen that the metallic filament is still visible in the dark at a much lower voltage than the

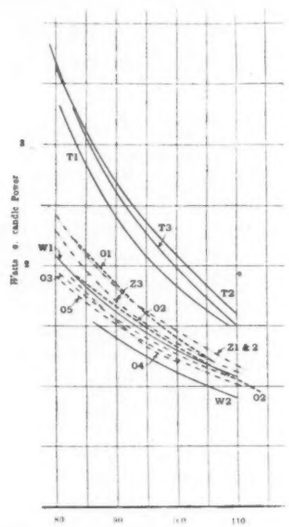


FIG. 3.—VOLTAGE-W. P. C. CURVES.

carbon filament; the average figures, expressed in per cents of the working voltage, being 4 per cent for the metallic and 16 per cent for the carbon. These experiments were carried out with extreme care in a perfectly dark room.—Lond. *Elec.*, July 26.

Enclosed Arc Lamp.—An illustrated description of the Helia arc lamp made by Kolben & Company. It is an enclosed arc lamp for direct current or alternating current for voltages between 100 and 150, and for currents between 3 and 8 amperes. The life of the upper carbon is from 40 to 50 hours with direct current and from 20 to 30 hours with alternating current. The rest of the upper carbon can be used again as lower carbon. The specific consumption without the globe is 0.465 watt per mean hemispheric hefner candle; with a frosted globe, through which the arc is no longer visible, the consumption is 1.026 watts per hefner candle; but such globes are required only for interior lighting, in offices, etc., while under ordinary conditions, with a less absorbing globe, the specific consumption is between 0.6 and 0.8 watt per hefner candle. The special feature of the lamp is that it is perfectly air-tight and that very thin carbons of 5, 6 and 7 mm diameter are used. It is stated that the arc burns very quietly.—*Elek. und Masch.*, July 21.

Mercury Arc.—J. POLAK.—The conclusion of his articles, in the last instalment of which he discusses the use of the mercury arc for rectifying purposes.—*Elek. Zeit.*, July 25.

Power.

French Power Transmission System.—E. GAISSET.—The first part of an illustrated description of the electric power transmission system of the Société Méridionale. The company has a three-phase network with a frequency of 50 in the cities of Carcassonne and Narbonne and a direct-current, three-wire distributing system, with a voltage of 220 between the outers. The three-phase network consists of a double feeder at 20,000 volts, 65 kilometers length and three lines at 17,000 volts with 5000-volt branches and a total length of 600 kilometers. The 5000-volt branches supply electricity to 150 towns. There was formerly only one hydroelectric generating station, while lately a steam station and a second hydroelectric station have been installed. The article begins to describe in detail the equipment.—*L'Eclairage Electrique*, July 27.

Producer Gas.—W. A. BONE AND R. V. WHEELER.—An Iron and Steel Institute paper on the use of steam in gas-producer practice. This paper contains the results obtained at trials on two Mond producers. Varying the temperature by altering the proportions of air and steam in the blast causes the quality of the gas to deteriorate if the saturation temperature exceeds 65 degs. The thermal efficiency and other considerations show the best saturation temperature to be about 60 degs. —Lond. *Elec.*, July 26.

Induced Draught.—A. J. CAPRON.—An Iron and Steel Institute paper on induced draught, with hot-air economizers, for steel works and blast-furnace boilers. The author describes a system of induced draught in connection with hot-air economizers, which utilize the waste heat from the boiler by heating the air required for combustion. Examples of the adaptation of this system to various types of boilers and some comparative figures are given. The efficiency is much increased.—Lond. *Elec.*, July 26.

Cranes.—A very full, illustrated description of various direct-current cranes made by a British company.—Lond. *Elec. Rev.*, July 19.

Electric Pumps.—An illustrated account of tests of a centrifugal pump installed in a mine in Germany and driven by a three-phase motor.—*Elek. Zeit.*, July 25.

Starting Gas Engines.—To start a gas engine which drives a direct-current dynamo, L. Neu makes use of the booster which serves for charging the battery.—*L'Industrie Electrique*, July 25.

Steam Turbines.—F. NIETHAMMER.—An article on steam turbines and turbo-dynamos and their reliability in practical service.—*Elek. und Masch.*, July 21 and 28.

Rolling Mills.—H. ALEXANDER.—A summary of the work done by the Allgem. Elek. Ges. in recent years with respect to electric equipment of reversing rolling mills.—*Elek. Zeit.*, July 25.

Traction.

Mountain Railway.—An illustrated description of the new electric railway from Muenster to the "Schlucht." A trolley system at 750 volts is used. The line is a combined adhesion and rack road. The four-axled motor car is provided with four 85-hp motors, two of which drive the running wheels in the usual manner, while the remaining two are permanently connected to the gearing which engages in the rack. On the adhesion section only the two motors are in use, and these drive the wheels through a single reduction gear in the ordinary way. The other two motors are not then in use. On the rack sections, however, all four motors are employed. The rack motors work with a double reduction gear, and the adhesion motors are kept in series to run with a high torque at a low speed. All four motors are controlled by a single controller. Series-parallel control is employed.—Lond. *Elec. Eng'ing*, July 25.

Glasgow.—An abstract of the annual report of the municipal tramways of Glasgow which shows a substantial surplus on the year's working. The total costs per car-mile, not includ-

ing capital charges, are 11.442 cents, a figure which is brought up to 20.612 cents by the addition of all capital charges. The cost of energy works out at 2.112 cents per "unit" supplied, including a proportion of management and capital charges.—Lond. *Elec. Eng'ing*, July 18.

Railway Electrification Proposals in Italy.—A general article discussing the advantages of electrification of railways with reference to a recent article of C. R. King and to the criticisms which have been made that for improvement of the whole service it would be more economical to build new lines and retain steam traction than to change to electric traction.—Lond. *Elec. Eng'ing*, July 18.

Installations, Systems and Appliances.

Interrupter for House Installations.—An illustrated description of a device of Zambelletto and Ballerini for cutting off the supply to a house when the current passes beyond the value

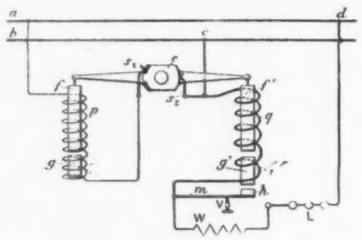


FIG. 4.—INTERRUPTER FOR HOUSE INSTALLATION.

agreed on by contract. In Fig. 4 the conductors of the network are represented by *a, b,* while the house installation is represented by *c, L, d,* and *L* represents lamps, etc. The interrupter consists of two coils *p, q,* the former of thin wire, the latter of thick wire. The coil *p* is connected across the line, while the coil *q* is in series with the lamps *L*. *f* and *g*, and f^1 and g^1 are pieces of iron. Variations of the voltage in the network are without effect on the equilibrium of the system, but if the current consumed in the lamps *L* increases beyond the predetermined value, the iron piece, *h*, mounted on the lever *m* is attracted and the contact *m v* is broken.—*L'Industrie Electrique*, July 10.

Fallacies of Free Wiring.—G. B. Barham.—The author states that the greatest fallacy in "free wiring" is the term "free." The methods of charging under the usual systems of free wiring lead to dissatisfaction and to an eventual decrease in energy consumption. The system does not encourage long-hour consumers, and a fixed charge per lamp per year is not an attraction.—Lond. *Elec.*, July 26.

Wires, Wiring and Conduits.

Electric Conduit Fittings.—An illustrated description of a design of conduit fitting devised by W. Schmahl. The distinctive feature is that shoulders are provided against which the rough ends of the conduit butt, and are thus removed from possible contact with the wires.—Lond. *Elec. Eng'ing*, July 18.

Electrochemistry and Batteries.

Fixation of Atmospheric Nitrogen.—F. Howles.—A paper in which the author gives a review of the principles of the electrothermic combustion of atmospheric nitrogen and presents an outline of the various technical methods which have been suggested. A yield of 650 kilos of nitric acid per kw-year represents the greatest output so far realized. Two ways of improving matters are possible, either by increasing the flame temperature or by more rapidly removing the gas mixture from the arc by means of greater air velocity without increased dilution. The author then discusses the absorption of nitric oxide and the preparation of nitric acid. Some figures on energy cost are given.—Lond. *Elec.*, July 19.

Electrolytic Refining of Bismuth.—A. Mohn.—An illustrated article. The parting of a Mexican lead-bismuth bullion was carried out by a combined process, including, first, electrolytic refining of lead by the Betts' process; second, purification of the slimes; third, electrolytic refining of bismuth; and, fourth, electrolytic refining of silver and gold. The apparatus for the refining of bismuth is analogous to that used in the Balbach silver refining process. The electrolyte is a solution of bismuth chloride and free hydrochloric acid. Electrolysis is carried out with a cathodic current density of 20 amperes per square foot, while the current density at the anodes is three times this amount. The voltage at the terminals of the cell is 1.2.—*Electrochem. and Met. Ind.*, August.

Ammonia Gas by Means of the Electric Arc.—E. Briner and E. Mettlen.—A brief account of an experimental investigation of the influence of pressure on the synthetical formation of ammonia gas by the action of an electric-spark discharge on a mixture of nitrogen and hydrogen.—Lond. *Elec.*, July 26.

Sterilization of Water by Ozone.—G. Erlwein.—A brief paper on the Siemens ozonizing apparatus and the use of ozone for the sterilization of drinking water.—Lond. *Elec.*, July 26.

Hydrates in Solution.—Four different papers presented before the Faraday Society on the subject of hydrates in solution, namely: By W. R. Bousfield and T. M. Lowry on "Thermochemistry of Electrolytes"; by J. C. Philip on "Hydrates in Solution"; by G. Senter on "Methods for Determining the Degree of Hydration," and by A. Findlay on the "Stability of Hydrates."—Lond. *Elec.*, July 26.

Units, Measurements and Instruments.

Photometer.—J. S. Dow.—An abstract of a (British) Physical Society paper on a form of photometer in which the cosine law is utilized. In this form it is unnecessary to move either the photometer or the sources of light. The adjustment of the illumination of the photometrical surfaces is carried out in the photometer itself by the rotation of a Ritchie wedge about the boundary line between the photometrical surfaces as axis. The ratio of the candle-powers of the two sources of light compared can then be read off on a suitably calibrated scale attached to the photometer. This type of instrument is very convenient. Attention is drawn, however, to the possibility of "angle-errors" and the means of avoiding them. This instrument can be used on the equality of brightness principle, or by utilizing an oscillating lens, as a flicker photometer. The results of using these two photometrical methods are, in this case, in very good agreement. An experiment was then shown illustrating the behavior of the "rods" and "cones" as regards flicker. At strong illuminations, when the cones are predominant, the perception of form and color is most acute when the central portion of the retina is utilized; but at low illuminations, when the rods are in action, visual acuteness is best when the outer region of the retina is used. In the same way the perception of flicker was demonstrated to be most acute over only the portion of the retina removed from the center of the eye when a weak illumination is employed. A distinction must be drawn between "rod-flicker" and "cone-flicker." Some experiments were then shown illustrating the detail revealing powers of red and green light. A green or blue surface loses in luminosity as the image of it fades more and more towards the center of the retina. But apart from the question of luminosity, the red end of the spectrum gives the best definition in the case of distant vision and the blue end in the case of very close vision. This arises from the want of achromatism of the eye. Two exactly similar patches of red and blue light were thrown upon a screen on which a black and white chessboard-pattern had been traced. The black and white squares were then seen to be more sharply defined when illuminated by the red light, in spite of the fact that the illumination due to the blue light was much the brighter of the two. The red end of the spectrum is, therefore, in general the most effectual portion for the illumination of clocks, shop signs and objects which must be viewed from a distance.—Lond. *Elec.*, July 19.

Hot-Wire Oscillographs and Hot-Wire Wattmeters.—J. T. Irwin.—An abstract of a (British) Physical Society paper. The principle of the author's hot-wire oscillograph has already been described in the Digest. In the present lecture he showed the following experiments with the oscillograph. The p. d.

from a rotary converter with the ripples due to sparkling damped out by resistance in the condenser circuit; with the ripples shown at their proper size with critical damping; with the ripples very much exaggerated owing to want of damping. He also showed the periodic discharge of a condenser through a self-induction, first, with a small resistance in circuit and, therefore, an oscillatory discharge, and second, with a large resistance in circuit and the oscillations damped out. He then showed the p. d. across the stator of an induction motor and the current in the rotor below, above, and at synchronous speed, when running as a two-phase machine and as a single-phase machine. The current through and the p. d. across the armature of a single-phase commutating compensated motor run up to and above synchronous speed was then shown, first, with the auxiliary brushes short-circuited showing the current and p. d. in phase with each other at synchronous speed, and second, with the auxiliary brushes open-circuited showing the p. d. and current differing by nearly 90 degs. in phase. The lecturer then showed a circle and a straight line produced by combining, by means of a beam of light, the vertical harmonic motion of a mirror with a simple harmonic motion of the oscillograph due to a sine wave of current, the circle being produced when the two movements were at 90 degs. difference in phase, and the straight line when the two movements were in phase. Finally a hysteresis loop was demonstrated for glass-hard steel wire, showing the rounding off of the tips at a frequency of 40 per second. He also showed a new type of synchronous motor which he has invented and which can be run easily at synchronous or half-synchronous speed. This motor consists essentially of a series motor with laminated field cores and with two points on the commutator, 180 degrees apart short-circuited.—Lond. *Elec.*, July 19.

String Electrometer.—C. W. LUTZ.—Einthoven's string galvanometer is used either with direct or with alternating currents. It can also be adopted to electrometry. The author describes a new way of doing this. The quadrant electrometer suffers from the disadvantages of a large capacity and inertia, and a lack of portability. The electroscope, on the other hand, is not very sensitive, has a small range, and cannot be made self-registering. The author uses two insulated brass plates mounted in an earthed magnalium frame. Between these plates a Wollaston wire, 0.001 mm in diameter and 10 cm long, is stretched, and its position is read by means of a micrometer microscope. The instrument is kept dry by means of sodium bulbs. There are four different methods of connection. With an auxiliary potential there is either a "string" method or a "plate" method. In the former the string is charged to the unknown potential, and the plates are given equal and opposite known charges, derived from a battery of 50 small accumulators. In the "plate" method one plate is earthed, the string is positively charged, and the other plate charged to the unknown potential. Without an auxiliary potential there is the "double" method in which one plate is earthed and both the string and the remaining plate are charged to the unknown potential, and the "influence" method in which one plate is removed some distance from the string, both plates are earthed, and the induction of the nearer plate deflects the charged string towards it. The author claims simplicity, portability and precision for this instrument. No damping is required. There is great portability, range and sensitiveness. Insulation is very high, and optical projection and self-registration easily secured. In the last two methods the deflection is independent of the position. The capacity ranges from 5 cm to 15 cm, according to the method used.—Lond. *Elec. Eng'ing*, July 25.

Miscellaneous.

Transmission of Pictures.—BLONDIN.—An abstract of a paper read before the International Society of Electricians in Paris, in which he described a new method of picture-transmission, due to Carbonnelle, in which selenium is not used. After experimenting with various selenium arrangements, the inventor abandoned this method for another which seemed to promise more success. This system, which, since March 1, has been submitted to official tests on the telegraphic circuit between Brussels and Antwerp and back (a total distance of about 57 miles) is very simple. There are two cylinders revolving synchronously, one at the transmitting and one at the receiving end. On the first is wound a sheet of metal on which is written or photographed by a special process the messages or other matter which is to be reproduced. On the second is a layer of some plastic substance, such as wax or of some soft metal, such as lead, or even sheets of white paper, separated by carbon paper. A metallic style, which is connected to one pole of a battery, presses on the surface of the conducting sheet carrying the message. This latter is connected to earth through the support. The other pole of the battery is connected to the line. The metal style has a lateral motion along the axis of the cylinder. At the receiving end is a telephone connected to the line and to earth. This receives a current varying with the movements of the transmitting cylinder. A graver fixed to the diaphragm traces a groove in the wax or lead, or draws lines on the sheets of white paper. The action is as follows: When the transmitting style passes over an insulating part of the message, no current passes to the line and the receiving point presses on the surface of the receiving cylinder. When, on the contrary, a current flows, the style is raised. A reproduction in wax, in lead or in black lines on white paper, is thus obtained. It is claimed that, as regards the speed of transmission, this apparatus is superior to that of Korn. In the Carbonnelle system a photograph measuring 9 cm x 18 cm was transmitted in 80 seconds. By Korn's method it takes about 12 minutes to send a photograph 13 cm x 18 cm and to get a reproduction 6 cm x 10 cm. To obtain the various degrees of light and shade one of the following methods is employed, either a special reticulation of gums or gelatine bichromates, or a heliograving process, or base of metallic salts obtained by a special method, or those obtained by the carbon process. In the first two methods the thickness of the layer is proportional to the degree of light and shade and the current varies in the same proportion. In the case of metallic salts the thickness of the layer is the same all over, but the strength of the salt is different at different places. When carbon is used the layer is again of varying thickness.—Lond. *Elec.*, July 19.

High-Speed Wireless Telegraphy.—The large Poldhu station of the Marconi Company still signals to Atlantic liners at the rate of about 15 words per minute. With such a comparatively slow speed wireless messages are very costly and it is of great importance to develop high-speed working. Results obtained in tests of the British Post Office are promising and indicate that Wheatstone working is a practical possibility. In these experiments the received oscillations actuated a wireless receiver, which, in turn, acted on a syphon recorder, causing the Morse signals to be written in a continuous wavy line.—Lond. *Elec. Rev.*, July 19.

Pilot Wires and Electric Light Cables for Telephone Lines.—R. HIECKE.—An illustrated translation of his German paper, mentioned before in the Digest, and describing a method of telephony between the generating station and chief sub-stations by using the pilot wires and the electric light cables themselves as telephone lines.—Lond. *Elec. Eng'ing*, July 25.

BOOK REVIEWS.

L'ELECTRICITE CONSIDEREE COMME FORME DE L'ENERGIE. Par Lt.-Col. E. Aries. Paris: A. Hermann. 58 pages. Price, 2.50 francs.

The purport of this pamphlet is to call attention to the part played by the real, material medium rather than by the hypothetical ether of space. Electric potential and quantity; the causes of electrostatic phenomena, energy transformation and Carnot's cycle are all considered in this effort to explain the unknown by means of the known and the invisible by the visible.

L'Annee Electrique. 1907. By Dr. Foveau de Courmelles. Paris: Ch. Beranger. 362 pages. Price, 3.50 francs.

As usual, this yearly volume contained brief notices of electrical occurrences, activities and achievements. Electrochemistry, atmospheric electricity, wireless telegraphy, radiography and the applications of the electric current to curative medicine receive due attention. The volume closes with a seven-page obituary notice of the late Prof. Pierre Curie (b. May 15, 1859; d. April 19, 1906).

Lifting Electromagnets.

The accompanying illustrations show several forms of lifting electromagnets brought out by the Cutler-Hammer Clutch Company, of Milwaukee, Wis. These are made in sizes from a 10-in. magnet for lifting plates, rails, small castings, etc., up to a 50-in. or 52-in. magnet designed for handling pig iron, scrap, etc., and capable of lifting a 10-ton "skull-cracker." A 50-in. magnet weighs about 5000 lbs. It consists of a hollow steel casting in which the magnetized coil is placed. This coil is built up of alternate layers of copper and asbestos and is insulated from the cast-steel frame by thick sheets of mica. Under test the coils of these magnets have been heated to 470 degs. Fahr. without injury. The corrugated form of construction shown serves two useful purposes; it provides a greater surface for heat radiation and also forms niches to protect the heads of the bolts which fasten the removable pole piece to the magnet frame from injury. As a further aid to heat radiation the magnet frame is cast with a central aperture through which air may freely circulate. The lifting capacity of the electromagnet depends, of course, on the nature of the material handled. Under favorable conditions a 50-in. magnet will lift as much as 20,000 lbs., while under adverse conditions the same magnet may not lift more than 1000 lbs. or less. Various forms of material also require various forms of magnets. For handling plates, rails, tubes and material of a similar nature the magnets are usually made rectangular in form and are preferably operated in pairs, the two magnets being placed on a balancing bar to which the crane hook is attached. Magnets for handling pig iron, scrap, "skull-crackers," etc., are, as a rule, circular in form and are constructed with much greater lifting capacity. A 75-lb. magnet is shown in Fig. 3 lifting an 800-lb. electric car lighting generator. Lifting magnets of large size, designed for use with pig iron, scrap, etc., are made concave on the under side, since this form is best adapted for handling material of irregular shapes. These magnets may be easily adapted for handling large masses of metal with plane surfaces by inserting in the central aperture an auxiliary pole piece so proportioned as to extend the inner pole downward to the level of the outer pole, thus insuring immediate contact of both poles with the object to be lifted. Pole shoes are fitted to all the lifting magnets and these are secured by through bolts. The removable pole piece and the through bolts that fasten it to the under side of the magnet frame are clearly illustrated in Fig. 1, where the electromagnet is shown handling steel stampings. In this case the magnet was not lowered onto the stampings, but was brought to within about 3 ft. of them when the perforated steel plates rose to the magnet as shown.

FIG. 2.—TEN-INCH MAGNET LIFTING THREE TANK HEADS.

FIG. 1.—STEEL STAMPINGS BEING LIFTED BY MAGNET.

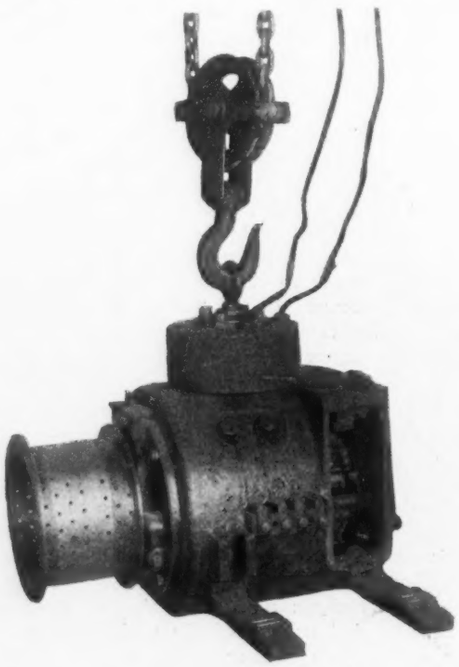
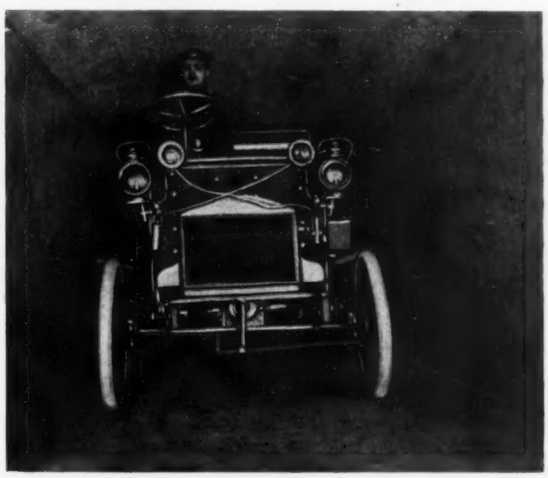


FIG. 3.—TEN-INCH MAGNET LIFTING 800-LB. GENERATOR.

The magnets will be found serviceable wherever pig iron, metal plates, tubes, rails, beams, scrap or heavy castings of iron or steel are to be handled. All that is necessary in work of this sort is to lower the magnet on to the material, close the circuit and lift the magnet. In foundries and rolling mills magnets may be utilized for lifting and transporting metal too hot to be touched with the hand.

Automobile for Temporary Freight Haulage in Water Conduits.

On page 280 of our issue for Aug. 10 mention was made of the use of automobiles as traction locomotives for hauling freight through the water tunnel of the Kern River plant of the Edison Electric Company, Los Angeles, Cal. An illustration of one of the two automobiles is shown herewith. The



AUTOMOBILE IN TUNNEL.

tunnel through which these machines acted as locomotives when the surface roads were impassable have a total length of about 8 miles, the average haul being about 5.5 miles. The two machines accomplished a total freight locomotive traffic of 2750 ton-miles. The automobiles were of the Lambert friction drive type, each being equipped with a 20-hp gasoline motor. The wheels were fitted with heavy, solid rubber tires.

Potato Peeling by Electricity.

An ingenious application of electric motor drive is shown in the accompanying illustration of an equipment devised for

MOTOR-DRIVEN POTATO PEELER.

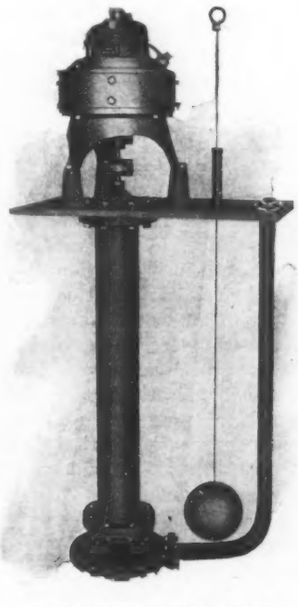
the purpose of peeling potatoes. This group of apparatus shows a half horse-power alternating-current motor, built by the Century Electric Company, of St. Louis, directly geared to a Victoria vegetable paring machine, made by the Robinson Machine Company, of Newark, N. J. This device will peel and wash a barrel of potatoes in about five or six minutes, while turnips, carrots or beets can be pared at equivalent rates of speed. The problems involved in working out such a device were not easy of solution, but Mr. H. Robinson appears to have placed in public service a highly ingenious and practical apparatus, affording great economy of time and labor.

The peeling in the machine is done by the principle of rotating and agitating the potatoes inside of the machine, against rough, abrading surfaces, while a stream of water plays on them, discharging the waste into the sewer. It may be naturally deducted that the peeling is accomplished with about one-fourth of the waste on the potatoes when done entirely by hand, as the machine only removes the outer thin skin of the potatoes, leaving all the most nutritious part on the potatoes to be cooked and eaten.

These machines are driven either by a power belt or direct connected with a motor, and the availability of electrical circuits renders the use of motors very popular in this respect. It is stated that no fewer than 40 of these machines have already been installed in the U. S. Navy, where instead of a big gang of men sitting around a long time at the job, two or three jackies in 15 minutes can do all the potato peeling necessary for a whole day's meals.

Vertical Sump Pump.

The accompanying illustration shows a useful machine made by the Tacony Iron Company, of Philadelphia and New York, for sump pit drainage. It is a specially designed centrifugal pump supported from the under side of a bedplate by a pipe through which the shaft runs; the vertical motor and the thrust bearing to carry the weight of the moving parts are mounted on the upper side of this bedplate. Being designed to have the pump proper entirely submerged in the water, no troubles from lack of priming occur and because of this no valves of any kind need be used, so that there can be no trouble or annoyance due to solid matter lodging in such devices. A pump of this type arranged to stop and start automatically by means of a float and special electric switch makes an admirable device to drain water from cellars or pits. The company also



MOTOR-DRIVEN SUMP PUMP.

makes pumps having specially large passages for pumping sewage, and single and multi-stage turbine pumps for house tank service or other use.

Helmet Type of Reflector.

A new reflector has been recently brought out by the National X-Ray Reflector Company, of 247 Jackson Boulevard, Chicago, which is designated the "Helmet" reflector. It was scientifically designed to meet the requirements of lighting high and shallow windows; the majority of windows at the present time being of this class. It is suited to the lighting of all windows where the depth of the window is not over one-half the height of the lamps above the bottom of the window, where the lamps are as high above the level of the top of the back of the window as the window is deep. This meets the conditions in the great majority of show windows. It is intended to produce an approximately uniform illumination over the goods as ordinarily placed in show windows. This reflector is claimed to mark a decided advance over anything heretofore offered for lighting the class of windows mentioned for the following reasons:

In the first place, it is designed to utilize a 125-watt Gem incandescent lamp; thus giving the customer at once the advantage of a 25 per cent increase in efficiency over the old style carbon filament lamp. It has the further advantage that it is also adapted to a 105-watt tungsten lamp; so that the user can install these very high efficiency lamps as soon as they are placed on the market. Latest improvements in incandescent

FIG. 1.—HELMET WINDOW REFLECTOR.

lamps have therefore been anticipated. Fig. 1 shows the external appearance of this reflector. It has one side partially flattened and extended down lower than the rest of the reflector. This flat side is placed next to and parallel with the window pane, and is designed to avoid as far as possible the wasting of light on the sidewalk and detracting from the value of the window illumination by exposing the lamp to passers-by. The reflector is unusually large, being about 12 ins. in diameter and 11½ ins. high. This size was necessary to secure high efficiency of window illumination, by catching as much of the light as possible and reflecting it in useful directions. Another important reason for the unsymmetrical design of the reflector was to make it easy to install without mistakes. The makers realized in adopting this design that many excellent reflectors of conical form are commonly misused in window lighting because the average person who installs and uses these reflectors does not understand the importance of pointing them at the proper angle. This new reflector was therefore intended to be as nearly "fool-proof" as possible, and it was designed so that the lamps point straight down. Efficient installation is a very simple undertaking. Furthermore, by having the lamps pendant, use can be made of the new tungsten lamp, which would not be the case if the lamps were at an angle.

The efficiency of this reflector for window illumination for the size of windows for which it is intended, is remarkably high, as can be seen from Fig. 2, which shows photometric curves plotted from tests made by the Electrical Testing Laboratories, of New York. In these tests the reflector was equipped with a 125-watt clear-bulb Gem lamp, giving 50 mean horizontal candle-power. The reflector was held in a position as used in practice with a standard 3¼-in. holder. The lamp was placed in such a position that the plane parallel to the loops of the filament made an angle of 45 degrees with the flat side of the reflector. In one curve of Fig. 2 is shown the apparent candle-power at various angles in a plane at right angles to the flat side of the reflector, and in another curve is shown the apparent candle-power at various angles in a plane parallel to the flat side of the reflector, or, in other words, the sidewise distribution, as it would be installed in a window. From Fig. 2, it is seen that over 200 candle-power is given for a distance of 40 degrees to the left of vertical in the direction in which it is most useful in window lighting; while for a few degrees the candle-power is over 400. The maximum candle-power is directed so as to give high illumination on the goods placed in the bottom and front of the window. As elevated goods—*i. e.*, those on higher levels—are usually placed further back in the window, a lower intensity is needed; and these

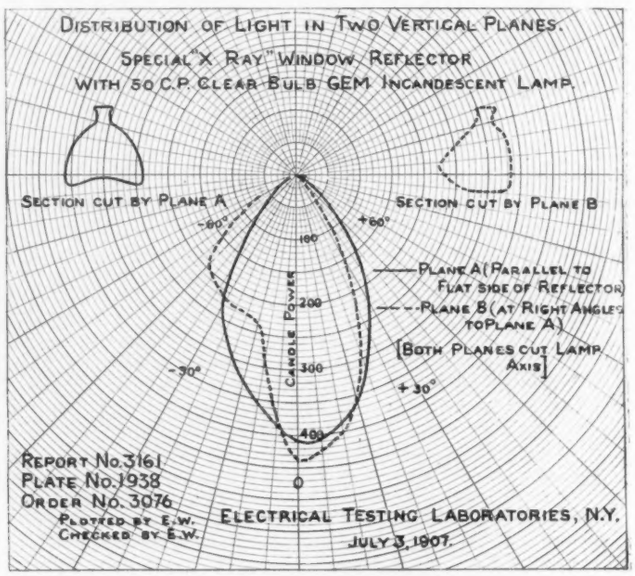


FIG. 2.—LIGHT DISTRIBUTION WITH A HELMET REFLECTOR.

requirements are met by the reflector. A very small amount of light is thrown outside the window on the sidewalk.

Besides window lighting a number of other useful applications of this reflector will suggest themselves to illuminating engineers, most notably the lighting of audience rooms of all kinds where the lamps themselves are concealed behind ground glass skylights or beams, and where it is desired to throw the light sidewise and forward and have as few rays directed back into the eyes of the audience as possible.

For the lighting of high, shallow windows, the makers are putting out this reflector with the claim, based on these photometric curves, that one 125-watt Gem lamp with this reflector will give the same results as three 55-watt common incandescent lamps used in the most efficient window reflectors for high, deep windows that had been offered up to the time this reflector was designed, while in many cases where reflectors unsuited to the window have been heretofore used, one 125-watt Gem lamp will give the same results as four or five common 16-cp, 55-watt lamps. With tungsten lamps, having twice the efficiency of Gem lamps, the saving would be of course even more marked. The makers claim the honor of being the first to put out a window reflector designed for the new large high-efficiency incandescent lamps.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The trade conditions of the whole country appear to be excellent, and manufacturers and merchants are well satisfied with the volume of orders. In New York, it is said, forward dry goods orders for the spring have been exceptionally good, and other textile lines of all kinds feel a brisk demand. Warmer weather in August has helped to move things and to clean up summer stocks. There are some lines of production more responsive than others to the declines in Wall Street, and they have experienced depression—such as automobiles and jewelry—but these do not bulk very big in the national consumption even of luxuries. The state of the crops is cheerful, as the conditions have nearly everywhere improved, as to wheat and corn; while the cotton outlook is very favorable. The iron and steel market has been slightly duller, but the business is in excess of 1906, and some slowing down was inevitable, if not indeed desirable. Copper has continued to head slowly toward lower prices, and electrolytic has even been quoted at 18 cents. Bank clearings for the week ending Aug. 15 aggregate $2,761,355,000, 4 per cent over last week and 6 per cent over this week last year. Outside of New York exchanges amount to $1,045,997,000, about one-tenth of 1 per cent under last week, but 10 per cent over the week last year. Business failures for the week ending Aug. 15 number 146, against 157 last week, 143 in the like week of 1906, 147 in 1905, 203 in 1904 and 166 in 1903.

THE PAWLING & HARNISHFEGER COMPANY, of Milwaukee, large builder of traveling cranes of every description, has twice been obliged, due to the increase of business, to enlarge its original plant, built only a few years ago. The second addition to be made is now practically completed. The main building, housing and bridge, erecting, assembling, machine, electrical and stock departments, is 260 ft. x 355 ft. The addition is 100 ft. wide and extends the entire length of the main building, or 355 ft. It is built of brick and steel, with a saw-toothed roof, and when it is occupied the entire floor space will be 127,800 sq. ft. New machinery will be installed in the addition, and the crane runways and sprinkler system of the main building will be extended. In consequence of the increased floor space and the necessary new machinery for it, it has been necessary to make corresponding additions to the power plant. An Allis-Chalmers cross-compound Corliss engine of 150 horse-power and electrical generator of 100 kilowatts capacity, together with a 400-hp Heine boiler and a Hawley down-draft furnace, have been added to the existing equipment, which also includes Allis-Chalmers engines. With these additions the aggregate boiler capacity will reach 1000 horse-power and the generating capacity 700 kilowatts.

BELL TELEPHONE STATISTICS.—It is stated from Boston that President Vail, of the American Telephone & Telegraph Company, has decided to discontinue issuing the monthly statements of instrument output and to substitute in their place a statement which will show the actual gain in new subscribers from month to month. The monthly statement has shown the movement of instruments between the parent company which owns them and the associate or licensed companies which rent them. The actual gains or losses in subscribers' stations from month to month, which, of course, measure the earning power of the Bell system, are not shown by the monthly figures of instrument output. In recent months the instrument statements have required constant explanation and it has been deemed better policy to abandon them entirely and put out figures which give actual results. Formerly every station was counted as two instruments, one transmitter and one receiver, which also led to confusion and mistake.

TELEPHONY IN AUSTRALIA.—Tenders are invited by the Commonwealth of Australia until Jan. 8, 1908, for the supply and delivery of one common battery switchboard and 3000 subscribers' telephones. Full particulars, specifications, bid forms, etc., may be obtained from the office of the Postmaster-General, Melbourne, Australia, or the Commonwealth Offices, 72 Victoria Street, S. W., London, England.

EXPORT TRADE FIGURES.—The chief of the Bureau of Statistics, Department of Commerce and Labor, reports the foreign trade of the United States for July and for the seven months ended July as follows:

July.	1907.	1906.	1905.
Imports	$124,764,063	$107,621,490	$84,512,606
Exports	128,765,354	111,550,440	107,930,421
Excess exports.	$4,001,291	$3,928,950	$23,417,815
Seven months ended July:			
Imports	$ 876,043,246	$744,980,820	$674,454,040
Exports	1,069,215,726	969,393,168	848,899,444
Excess exports.	$193,172,480	$224,412,348	$174,445,404

It will be seen that while there was a splendid expansion in exports the great increase in imports kept the trade balance in our favor down to a small figure.

STEAM TURBINE PLANTS.—Contracts have recently been closed with two municipalities for Allis-Chalmers turbine units, one for Columbus, Ohio, and one for Dunkirk, N. Y. The turbine for Columbus is a 1000-kw machine direct-connected to a 1000-kw alternator of the same design wound for 60 cycles, three-phase, 2300 volts. The Dunkirk unit is to be a 500-kw turbine direct-connected to a 500-kw Allis-Chalmers alternator wound for 60 cycles, two-phase, 2300 volts.

OPENING FOR PLANT.—Mr. P. J. Fulcher, secretary and treasurer of the Grottoes Board of Trade, Grottoes, Va., states in a letter just received that the town has no electric lamps, but needs them. The town is open, he says, to a proposition from some one who would like to put in the plant as a promising investment and he invites correspondence on the subject.

Financial Intelligence.

THE WEEK IN WALL STREET.—General conditions of demoralization were in evidence in Wall Street last week, and a remarkable decline in values took place. The strike of the telegraphers was not much of a factor, but the receivership for the Pope Manufacturing Company, which was unable to renew its loans, created a very uneasy and dispirited feeling, as it was inferred and even rumored that other industrial concerns might be in the same state. The scarcity of money was reflected in the failure of New York City to sell its $15,000,000 of bonds, and the actual tightness abroad was indicated by the increase in the Bank of England rate to 4 per cent. In fact, while the attitude and action of the government and state authorities in this country toward "bad trusts" and the railroads have done much to bring securities to their present low level, it is seen that the depression in stocks and the financial stringency are world wide, although our own market seems more sensitive than the others. Yet there are some good signs in the situation, and in a quiet way many purchases of good securities are being

NEW YORK

	Aug 13	Aug 20		Aug 13	Aug 20
Allis-Chalmers Co.	9¼	6½	General Electric	128¾	124½
Allis-Chalmers Co. pfd..	25	20	Hudson River Tel.....	—	—
Am. Dist. Tel.....	—	—	Interborough Met. com.	10	8½
American Locomotive...	53	52	Interborough Met. pfd.	29⅞	23
Amer. Locomotive pfd.	103	101	Mackay Cos.	62⅛	60½
American Tel. & Cable.	—	75	Mackay Cos. pfd.....	62	60
American Tel. & Tel...	105	105	Marconi Tel.	—	—
Brooklyn Rapid Transit.	46½	43	Metropolitan St. Ry...	—	42
Electric Boat	—	33	N. Y. & N. J. Tel.....	—	—
Electric Boat pfd.....	—	80	Western Union Tel....	75⅛	—
Electric Vehicle	—	—	Westinghouse com.....	130	130
Electric Vehicle pfd...	—	—	Westinghouse pfd.....	—	—

BOSTON

	Aug 13	Aug 20		Aug 13	Aug 20
American Tel. & Tel...	105	—	Mass. Elec. Ry. pfd...	54	52
Cumberland Telephone.	102	—	Mexican Telephone.....	—	2
Edison Elec. Illum.....	209	208	New England Telep...	—	108
General Electric	—	124½	Western Tel. & Tel....	—	—
Mass. Elec. Ry.....	12¼	—	West. Tel. & Tel. pfd..	—	—

PHILADELPHIA.

	Aug 13	Aug 20		Aug 13	Aug 20
American Railways.....	48	—	Phila. Electric	7⅞	7⅞
Elec. Co. of America...	8⅞	—	Phila. Rapid Transit...	16⅞	16⅛
Elec. Storage Battery..	47	46	Phila. Traction	93	—
Elec. Stor. Battery pfd.	—	—			

made at the present range of prices. Railway gross earnings still advance notably, and a gain of not less than 11.4 per cent was shown for July, the Pacific roads reaching a gain of not less than 19.4. Of course the net is relatively not so great because of higher wages and increased expenses, but it is clear that the roads are doing a business that taxes their capacity. Crops, moreover, have improved in prospect generally, and the treasury will relieve the monetary strain during the crop movement. The range of prices is indicated by our table of quotations.

MERGER IN NEW JERSEY.—The announcement has been made officially that a merger of the street railway companies controlled by the Public Service Corporation will be made in a corporation known as the Public Service Street Railway Company, with a capital of $38,000,000, consisting of 380,000 shares at a par value of $100 in cash. The securities of the various trolley companies now owned by the Public Service Corporation will be turned over to protect the new street railway company, which will be subordinate to the present Public Service Corporation. The parties to the plan are named in an agreement, dated July 30 last, as the North Jersey Street Railway Company, the Jersey City, Hoboken & Paterson Street Railway Company, formed by the merging of the Paterson Central Electric Company, Saddle River Traction Company, Palisade Railroad Company, White Line Traction Company, Paterson, Passaic & Rutherford Electric Railway Company, Jersey City, Hoboken & Rutherford Electric Railway Company, and Paterson Horse Railroad Company, and the United Street Railway Company of Central New Jersey, formed by merging the Elizabeth & Raritan River Street Railway Company and Elizabeth & Plainfield Central Jersey Railway Company. The officers of the consolidated company, who shall hold their respective offices for the first year or until others are chosen in their places, are: President, Thomas N. McCarter, Rumson, N. J.; vice-presidents, Charles A. Sterling, East Orange; Albert B. Carlton, Elizabeth; John J. Burleigh, Merchantville; secretary, Frederick Evans, New York; assistant secretary, Henry C. Stevenson, Newark; treasurer, James P. Dusenberry, Newark; assistant treasurer, Robert D. Miller, Jersey City.

THIRD MISSOURI DAM.—A special telegram from Helena, Mont., of Aug. 15, says: "The return of ex-Gov. S. T. Hauser from New York with the announcement that funds had been provided for the building of a third great dam across the Missouri River, and the further statement that part of the electric power thus developed would be utilized for the Helena-Butte electric line, means much for the mining industry of central Montana. Not only will cheap power be furnished for the immense district between the two cities, but also transportation to smelters for mineral output will be available at a nominal cost. This will apply to both East Helena and Butte, but as the one commercial smelter in the latter city is overtaxed with Senator Clark's output, East Helena will be the chief beneficiary. So crowded are the Anaconda and Great Falls smelters that there is reason to believe the Amalgamated will build a third plant on the shores of Lake Hauser, created by the backwaters of the second dam. Amalgamated interests are largely behind the three dams and also the Butte electric road. Another reason for selecting the Lake Hauser site is found in that a perfect and perpetual dump would be found in the Missouri River, thus obviating all lawsuits for damaged property, as was the case at Anaconda and Boulder. That stream would furnish the power to haul the ores to the smelter and take care of all refuse matter and at far less cost than railroad transportation. Gov. Hauser said this matter was in abeyance and not ripe for definite statements as yet. That it will be ultimately built, however, admits of no doubt. The new electric line will tap Corbin, Boulder, Basin, the Eva May and many other well known districts."

MILWAUKEE FRANCHISES.—A special dispatch from Milwaukee of Aug. 17 says: "Suit to annul the franchises that were granted the Milwaukee Electric Railway & Light Company was begun yesterday by the state against the company, the city of Milwaukee, the North American Company, its officers and the members of the 1900 Common Council who voted for the franchise. Among the defendants are John I. Beggs and Charles F. Pfister, of this city; Silas W. Burt, W. N. Cromwell, George R. Sheldon, Charles W. Wetmore, all of New York, and directors of the street railway company; former Mayor D. S. Rose and members of the Council of 1900. The suit has been commenced on allegations of District Attorney McGovern, of this city. On the strength of it the attorney-general makes an affidavit that the franchises were obtained through corrupt practices; that the directors of the company expended sums of money in corrupting Mayor Rose and the Council, and the court is asked to suspend the officials of the street railway and the North American Company from office and compel them to return the sums to the treasury of the companies and then to annul the franchises. Similar actions have been started by the same persons back of the suit during the past few years, but they have invariably failed. In addition to beginning the suit an order has been issued by Court Commissioner Donnelly compelling the defendants to appear before him on Aug. 26 and answer all questions as to how the franchises were obtained. The books of the North American Company and the street railway company are also demanded."

U. S. INDEPENDENT TELEPHONE.—The reorganization committee of the United States Independent Telephone Company, of Rochester, and of the Independent Telephone Securities Company made announcement last week that they had completed their plan for a readjustment of the finances of both concerns. The mortgages securing the bonds of both companies will be foreclosed and a new corporation organized under New York laws to take over the securities purchased. The new company will be capitalized at $6,000,000, and will execute a mortgage to secure a bond issue of $5,000,000, which will have a sliding scale of interest, 4 per cent for the first year, 5 per cent for the second year, and 6 per cent thereafter. Of these bonds $3,250,000 will be issued, which will be secured by the pledge of all the securities owned by the United States Independent Telephone Company and now subject to its mortgage, except the stock of the New York Independent Telephone Company. In addition to these all the stocks and bonds of the Independent Telephone Company of Syracuse and the Home Telephone Company of Utica now held by the Independent Telephone Securities Company will go to further secure the mortgage. Each bondholder who desires to participate in this plan must subscribe to bonds of the new corporation to the extent of 20 per cent of his present bond holdings. The new bonds are convertible into stock at par, and the bondholders will have the right to select the majority of the directors of the new company for an indefinite period.

DIVIDENDS.—Directors of the London Metropolitan District Railway have declared a dividend of 1⅝ per cent for the last six months on its 4 per cent guaranteed stock. Up to 1899 the full 4 per cent was regularly paid, but since that time the yearly rate has ranged from 2⅜ per cent in 1901 to 15-16 per cent in 1905. The regular semi-annual dividend of $3 per share has been declared on the preferred stock of the Northern Texas Electric Company, of Fort Worth, Tex., payable Sept. 3, 1907. Directors of the Georgia Railway & Electric Company have declared the regular quarterly dividend of 1½ per cent on the common stock, payable Aug. 20. Directors of the Galveston Electric Company have declared the regular semi-annual dividend of $3 per share on the preferred stock, payable Sept. 3. Directors of the Kansas City Railway & Light Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable Sept. 2. Directors of the Terre Haute Traction & Light Company have declared the regular semi-annual dividend of $3 per share on the preferred stock, payable Sept. 1.

CONSOLIDATED GAS.—The Consolidated Gas Company, of New York, has sold to N. W. Harris & Co. $5,000,000 of one-year 6 per cent notes. The money is to be used for general corporate purposes, to complete the first unit of the gas plant at Astoria and for additional equipment for the electrical department of the business. It is understood that practically all the issue has been placed with investors at 99. On the Stock Exchange yesterday Consolidated Gas stock broke 3½ points, to 104, partly on account of the news of the loan. In 1904 the stockholders subscribed for $20,000,000 of 6 per cent debenture bonds to supply funds for the Astoria plant.

NORTHERN OHIO EARNINGS.—With the year ending July 31 the Northern Ohio Traction & Light Company earned 3 per cent on its capital stock. After deducting the bond interest and the interest on the floating debt, the surplus for stock was $241,000, which is a little over 3 per cent on $7,938,000 stock outstanding. It is believed that the company will earn 4 per cent on the capital stock during the calendar year.

GENERAL NEWS

Construction News.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has filed a blanket mortgage for $25,000,000 in favor of the Old Colony Trust Company, of Boston, Mass., the proceeds to be used for retiring the outstanding securities and the enlargement and extensions of its railway system, power plant, etc. The first work will be the building of a large power house north of the city on a site purchased last year.

CLANTON, ALA.—The Electric Light Company of this city is working on its plant, and it is its intention to have lights all over town in a very short time.

CLARESHOLM, ALA.—The electric lighting plant of the Claresholm Milling & Elevator Company was destroyed by fire. This plant supplied electricity for lighting and power purposes for the entire town. The plant will be rebuilt.

GOODWATER, ALA.—The new electric light plant was put into operation Aug. 9 for the first time. The plant is owned by the city and run by water power.

ONEONTA, ALA.—The Oneonta Telephone Company has sold its line from this city to Hunt, via Rosa, Cleveland and Blountsville, to the Blount County Consolidated Telephone Company.

SEWARD, ALASKA.—The Seward Light & Power Company is contemplating installing a 100-hp engine in its plant. A. P. Dickinson is secretary and manager.

BEEBE, ARK.—We are informed that there is some talk here of constructing water works and an electric light plant, but nothing definite has yet been done.

HOT SPRINGS, ARK.—The City Council has granted to Atwood Benton, representing the Consumers' Electric Company, a franchise for an electric light plant to be completed within a year. The cost of the plant is estimated at about $135,000.

HOT SPRINGS, ARK.—According to announcement just made, a new electric power plant, to cost over $135,000, is to be commenced within 60 days by Atwood Benton. Mr. Benton says that the rate for electricity will be from 12 to 7 cents per kw-hour. A franchise fixing the price as above has been granted by the City Council. The Webster Gas Engine Company, of Kansas City, is said to be behind the project.

CALISTOGA, CAL.—The Board of Trustees of the village has advertised the application for the sale of franchise made by Henry Brown. The period of the franchise is 50 years, and the purpose is to erect poles and wires for transmitting electricity and for constructing a general electric light system.

FRESNO, CAL.—The City Council has refused the application of the Mutual Electric Light Company for a franchise in Chinatown and on certain streets of the city.

LODI, CAL.—Owing to some trouble with the flumes of the American River Electric Company this city has been without electricity, save for two or three hours at night, for a number of weeks. These troubles have now been remedied and electricity is being supplied as usual.

OROVILLE, CAL.—Temporary restraining orders were issued Aug. 6 by Judge Van Fleet in the United States Circuit Court setting aside the ordinances passed by the Oroville trustees, which fixed the light and water rates in Oroville. The company in a suit filed Aug. 6 maintains that the rates fixed in the ordinances were too low, and charges that the trustees in passing the ordinances were influenced by the platform of the Independent Municipal League.

SACRAMENTO, CAL.—W. H. Devlin has made an amended application and ordinance for a 50-year franchise for a railway by the Sacramento Southern Railway Company. The Western Pacific Company also put in the amended petition for a 50-year franchise. The latter company proposes to grant an easement over its subway embankment to the Northern Electric Company.

SAN FRANCISCO, CAL.—Work has already been begun on the electrification of the lines of the Southern Pacific Railroad in Alameda. A new power house is now being built at Fruitdale.

SAN FRANCISCO, CAL.—The City Electric Company has filed a mortgage upon its properties in this city to secure a $5,000,000, 5 per cent, 30 year bond issue, underwritten by the Central Trust Company of California.

SAN FRANCISCO, CAL.—Miller & Lux are contemplating the installation of a complete power plant for their abattoir and packing house on East Kentucky Street. The plant will have sufficient boiler capacity for the packing house, refrigerating machines and electric power plant. Plans may be seen at the office of B. Carroll Shipman, 604 Mission Street, electrical engineer.

SAN FRANCISCO, CAL.—The Board of Supervisors has passed an ordinance calling for the burying of all electric light, telegraph, telephone and street railway wires within eighteen months, under a penalty of not less than $200 or more than $500 for each day any poles, wires, cables or apparatus remain overhead after that time.

SANTA CLARA, CAL.—The work of running a branch of the Interurban railroad from the Meridian to the Santa Clara depot will be commenced.

SAN JOSE, CAL.—The franchise to erect poles and wires for transmitting electricity, petitioned for by J. A. Belloli, is offered for sale. Bids will be opened Sept 16.

STOCKTON, CAL.—The Stanislaus Electric Power Company, which has spent many millions in the erection of vast power plants and reservoirs on the Stanislaus River, will supply this city with electricity by the first of next February. The company is now securing right of way for a pole line to San Francisco, crossing through the southern part of San Joaquin County. Steel towers 50 ft. high and set 1000 ft. apart will be used for the transmission line. The company's plant on the Stanislaus River, east of Vallecito, will supply 30,000 horse-power, and as soon as this is in operation a duplicate plant will be built.

WILLOWS, CAL.—The Snow Mountain Power Company has been granted a franchise by the Board of Supervisors to erect poles and string wires in this county. A party of surveyors of the company is now at work laying out the location of a pole line. This is the company which has tunneled Eel River for its water power, and will be in the field as a rival to the California Gas & Electric Corporation, which now has a monopoly of the light and power business in Petaluma, Santa Rosa, San Rafael, Napa and a dozen other cities.

LA JUNTA, COL.—The Arkansas Valley Traction Company has been organized with a capital stock of $100,000 to construct an electric railway here and to run an interurban line to Rocky Ford, and to give Rocky Ford a local street car service.

CANAAN, CONN.—The Berkshire Power Company has completed its transmission line to Millertown, N. Y., from the plant near Canaan for the purpose of lighting the town with electricity.

HARTFORD, CONN.—The United Telephone Company is contemplating making improvements to its system, which will involve an expenditure of about $10,000. The greater part of the work will be at Huntington and Bluffton. The company intends, it is said, installing three new systems in this county.

SOUTH MANCHESTER, CONN.—The Glastonbury Power Company is changing its system from 2-wire to 3-wire, by means of which it expects to give better service.

WILMINGTON, DEL.—The Street and Sewer Department is reported to be considering the question of building a system of conduits for city wires, the space to be sublet to companies using wires.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Aug. 27, to furnish at the navy yards and naval stations a quantity of supplies as follows: Naval Academy, Annapolis, Md., schedule 166—turbo-generator, etc. Washington, D. C., schedule 213—motors. Norfolk, Va., schedule 208—electrical instruments, battery cells, electrical supplies, etc.; schedule 215—electric spares; schedule 218—electrical wire and cable, volt-meters, etc. Charleston, S. C., schedule 165—rotary shear; schedule 215—motor drive. Applications for proposals should designate the number desired. E. B. Rogers, Paymaster General, U. S. N.

JACKSONVILLE, FLA.—The Town Council, at a recent meeting, passed to its final reading the ordinance granting an electric light franchise to Charles Isted and associates.

ATLANTA, GA.—The municipal electric lighting plant, now under construction at Edgewood, will be completed by Sept. 15.

ATLANTA, GA.—The bill introduced by Senator Farmer authorizing water power corporations to exercise the right of eminent domain over the property of individuals was passed by a vote of 27 to 13.

AURORA, ILL.—The City Council is considering the question of making improvements to the electric light plant.

CHANDLERVILLE, ILL.—The city has granted a 10-year franchise to an electric light company headed by F. P. Schaafer.

CHURUBUSCO, IND.—A new alternator will be installed in the plant of the Churubusco Water & Light Company this fall. Miss J. Kingdon is owner and manager.

CLAY CITY, IND.—At a recent town meeting the Town Council was instructed to offer a franchise for an electric light plant, to take the place of the plant destroyed by fire in May.

COLUMBUS, IND.—The Indiana Heat, Light & Power Company has taken over the Columbus Street Railway & Light Company without the exchange of a dollar. The owners of the local property will take stock, to be issued by the purchasing company, to the amount of the purchasing price. E. C. Dearth, of Paris, Ill., is now in charge, but will soon be

succeeded as manager by John Crump, Jr. The new company promises to expend $75,000 in new machinery, improvements and extensions.

HUNTINGBURG, IND.—The Miessuer Brothers Company will put in a new 175-kw generator and an engine of 250 hp in its plant this fall. F. G. Katterbury is manager.

INDIANAPOLIS, IND.—The Board of Trustees of Woman's Prison will receive bids at the office of R. P. Daggett, 804 Lemeke Building, until Aug. 28 for the installation of a heating and lighting plant in the Woman's Prison. Faunce McKee is president of the board.

LEBANON, IND.—The Citizens' Electric Light & Ice Company is contemplating increasing the capacity of its plant, and will install a 175-kw, three-phase, 60-cycle, 2200-volt generator and a 250-hp Deisel engine. G. H. Wing is manager.

LOWELL, IND.—The Lowell Light & Power Company, recently organized by Clifford Wiley, of Chicago, Ill., and which purchased the local electric light plant, is making arrangements to build an entirely new plant, work on which will begin within a short time. The equipment of the plant will consist of two 150-hp boilers, with heaters and connections, a 125-hp engine and a 125-kw alternating-current generator.

MARTINSVILLE, IND.—The citizens are contemplating making improvements to the municipal electric light plant, which include the installation of a new dynamo, engine and new lamps. B. E. Lewis is manager.

RATHDRUM, IND.—The Rathdrum Electric Company is contemplating erecting new transmission lines and installing new transformers. H. R. Saunders is manager.

WELEETKA, I. T.—The Weleetka Light & Power Company is contemplating extensive additions and improvements to its water works system, and may install a 200-kw dynamo. D. F. Campbell is manager.

AVOCA, IOWA.—The Avoca Electric Light & Power Company is planning to increase its capacity by installing another 35-kw unit.

BURLINGTON, IA.—The Burlington Electric Light & Power Company is making arrangements to install a 60-hp gas engine and alternator in its plant.

CARROLL, IA.—The Carroll Electric Light, Heat & Power plant was sold to George H. Long, of Grand Rapids, Mich.

GRANT, IA.—The Grant & Elliott Telephone Company has purchased the Vetter line and will rebuild it.

GUTHRIE CENTRE, IA.—Plans are being made by the Guthrie Centre Electric Light Company to increase the capacity of its plant this fall. An engine, generator and two transformers will be installed.

NEW LONDON, IA.—The citizens are contemplating extending the municipal electric lighting system to Danville to supply the village with electricity for lighting purposes. Gilbert Johnson is manager.

SIOUX CITY, IOWA.—The contract for lighting the streets by electricity has been awarded to the Sioux City Gas & Electric Company. The contract is for 10 years and the price is $75 per arc lamp and $20 for 32-cp incandescent lamps per year.

ST. ANSGAR, IA.—The Wood Working Company is planning to change its electric plant from steam to water power. C. H. Miller is manager.

ANTHONY, KAN.—The Anthony Electric Light, Power & Fuel Company will soon install an ice plant. F. L. Bassett is manager.

CANEY, KAN.—The Caney Electric Light & Power Company is considering the question of installing a 150-kw, 1100-volt generator. John Heckman, of Coffeyville, is manager.

GARNETT, KAN.—The Garnett Electric Light Company is contemplating establishing a fan circuit. G. B. State is manager.

GARNETT, KAN.—The Garnett Electric Light Plant was sold on the 15th of this month to satisfy the claims of creditors. The equipment was in fairly good shape, and with some needed improvements should make a profitable proposition.

IOLA, KAN.—Extensions and improvements are contemplated to the municipal electric light plant, which will include the installation of a 150-hp tubular boiler and a 100-kw, alternating-current, 2200-volt, 60-cycle generator. W. E. Rutledge is superintendent.

DANVILLE, KY.—The Danville Light, Power & Traction Company is considering the construction of an electric railway in this city and an interurban line, taking in Lancaster, Stamford, Hustonville, Junction City and Harrodsburg. Representatives of the Westinghouse Company have been in the city in the interest of the company to prepare estimates of the cost of building the proposed system.

LONDON, KY.—Plans are being made to install a new engine in the plant of the London Electric Light & Power Company. W. F. Raymer is manager.

MAYFIELD, KY.—The Mayfield Water & Light Company is contemplating an extension of four miles to its street lighting service.

PADUCAH, KY.—Southern Electric Railroad Company capital increased from $50,000 to $1,000,000. The company proposes to build an interurban line through west Kentucky.

PARIS, KY.—The Paris Electric Light Company is contemplating increasing the capacity of its plant, and establishing a day service. The company will install an engine and boiler to provide for the day service. L. S. Allen is manager.

PRINCETON, KY.—The Princeton Light & Power Company is contemplating installing 47 additional arc lamps. G. G. Flower is manager.

RICHMOND, KY.—The Richmond Electric & Power Company is planning to install a 150-hp boiler in its plant. A. J. Forbes is manager.

STURGIS, KY.—The West Kentucky Coal Company is contemplating adding new machinery to its electric power plant. W. A. Chandler is manager.

UNIONTOWN, KY.—The Uniontown Light & Power Company is contemplating the installation of an additional boiler in its plant. G. F. Cecil is manager.

LAKE CHARLES, LA.—The Lake Charles Ice, Light & Water Works Company is contemplating installing a 100-kw Westinghouse-Parsons turbo-generator set and a 300-hp boiler in its plant in September. T. J. Bird is manager.

BELFAST, ME.—The water wheel at the plant of the Belfast Gas & Electric Company on the east side has been permanently set, and the new 225-hp boiler installed and other improvements made.

ELLSWORTH, ME.—The new power house of the Bar Harbor & Union River Power Company has just been commenced. The cofferdam on the east side of the river is nearing completion, and in a short time the buttresses will be under construction.

GLEN COVE, ME.—Work on the new power house extension is progressing rapidly. The addition, which is about 20 x 42 ft., is being built of concrete.

NORTH VASSALBORO, MAINE.—The town of North Vassalboro is now supplied with electric street lamps of 32 candle-power. The electricity is furnished by a small station built by Edward Chase at Shoddy Hollow.

PORTLAND, ME.—Bids will be received until Sept. 3 by the Board of County Commissioners for an engine, generator and electric wiring for the County Building.

SHAWMUT, ME.—Arrangements have been made for lighting the streets with electricity, the power to be furnished by the Waterville & Fairfield Railroad & Light Company.

SOUTH BERWICK, ME.—The Berwick & Salmon Falls Electric Light Company is contemplating about 20 miles of extension to its lines. F. E. Proctor, of Wakefield, Mass., is manager.

BLACKSTONE, MASS.—The town has won its fight against the Blackstone Electric Light Company for lower rates. The decision of the State Commission establishes the price to be paid on and after Sept. 1, for street lighting, as follows: For arc lamps burning all night and every night in the year the price shall not exceed $130 a lamp per year; incandescent lamps of 32-cp shall not exceed in price $30 per year; and when each of these lamps is burned until 1 o'clock the price shall not exceed $117 and $26 per year respectively. This makes a reduction of 4.4 cents per lamp per night for arc lamps and 1.8 cent for incandescent lamps.

EAST BRIDGEWATER, MASS.—The structural work at the new Edison plant will begin in about a week. The cement foundations have practically been finished and the steel work is being carted to the grounds.

EASTHAMPTON, MASS.—The Gas and Electric Light Commissioners have given notice of their decision to go over the franchise which the Selectmen of Easthampton had granted to the Easthampton Electric Company. The commissioners state in their report that there is not sufficient business for two electric companies here, the Easthampton Gas Company being already in the field.

HAVERHILL, MASS.—The G. W. J. Murphy Company has installed electrical apparatus for its machinery, which will hereafter be operated by electricity. The S. C. Pease & Sons Company has purchased machinery for wood working purposes, and will also operate its plant by electricity.

FALL RIVER, MASS.—The new station of the Fall River Electric Light Company is nearing completion, and it is hoped that it will be in operation by Sept. 1.

FALL RIVER, MASS.—The Southern Massachusetts Telephone Company has petitioned for permission to place its wires underground in this city.

FRANKLIN, MASS.—Owing to a defect in the boiler of the electric light station the town was without light for two nights.

MILFORD, MASS.—The Milford Electric Light & Power Company has petitioned the Selectmen for permission to erect a transmission line through Elm Street from Main to South Main and to the Hopedale town line. The company proposes to light the highway from the Hopedale line to South Milford.

NEWBURYPORT, MASS.—The Newburyport Gas & Electric Light Company is installing a new engine at its power house on Beacon Avenue.

NORWOOD, MASS.—The city streets were lighted for the first time in 30 years by electricity. The town owns the poles, wires and, in fact, the whole distribution system, but the electricity is supplied by contract. F. S. Barton is superintendent.

ORANGE, MASS.—The electric lighting plant, after having been disabled for a number of days, is again in operation.

PROVINCETOWN, MASS.—The Cape Light, Heat & Power Company has applied to the Board of Gas and Electric Light Commissioners

for permission to issue $25,000 in bonds, of which $14,000 is for the payment of the cost of extending its service to North Truro, Truro and South Truro.

CRYSTAL FALLS, MICH.—Robert Munns, city clerk, writes that the contract for building an addition to the power station has been awarded to the Falkenau Electrical Construction Company, of Chicago, Ill.

MUNISING, MICH.—Announcement is made of the sale of the holdings of the electric light and power company of this city from T. R. Belknap to M. A. Doty.

PONTIAC, MICH.—The Oakland County Telephone Company has been granted permission by the City Council to lay its wires in underground conduits on Saginaw Street and Oakland Avenue in this city.

TRAVERSE CITY, MICH.—At an election to be held soon the citizens will vote on the proposition of granting a franchise for a street railway in this city. The Carter Construction Company has applied for a 70-year franchise.

TRENTON, MICH.—The City Council is making arrangements to call a special election soon to vote on the proposition to sell the village electric light plant and purchase electricity from a private company, or to rebuild the municipal plant. Through a decision of the Supreme Court the village must move the lighting machinery out of the water works building.

DAWSON, MINN.—The village has bought the old local plant and will put in new machinery. The plant will require about 80-kw capacity, with a 90-hp engine and two boilers of 70 hp each. Mr. T. W. Miller has been the manager of the plant.

ST, PAUL, MINN.—It is reported that the Northwestern Telephone Company will erect two new branch stations, one on the West Side and the other on Payne Avenue.

HATTIESBURG, MISS.—The Union Electric Company, of Hattiesburg, has applied for a charter. The capital of the company is $5,000, and A. N. Sexton and C. J. Sutherland, of Hattiesburg, are reported interested.

BROOKFIELD, MO.—The electric plant of the Brookfield Electric Light & Power Company, which was recently destroyed by fire, is being rebuilt according to plans designed by Percy Markham. A new boiler and a three-phase generator will soon be installed, and other improvements are contemplatd. R. L. Wheeler is secretary.

SPRINGFIELD, MO.—A new telephone line will shortly connect this city and West Plains. Citizens of West Plains and Willow Springs are interested in the new enterprise.

STEVENSVILLE, MONT.—Geo. I. Walters, of Victor, is reported interested in the development of water power here and the installation of an electric light plant.

HELENA, MONT.—It is announced that the building of a third dam across the Missouri River near here will shortly be consummated. The dam will cost approximately $1,000,000, and with the two dams already built will develop upward of 50,000 horse-power. This will be utilized to a great extent in the mines, smelters, street car and lighting systems, etc., between Helena and Butte.

ELY, NEV.—The Nevada-California Power Company is planning the construction of a transmission line to Ely, which, it is claimed, will be the longest transmission line in the world and will carry the highest voltage—100,000 volts—from its power house at Bishop, Cal. The company has entered upon an era of construction work which will supply practically all the mining camps of Southern Nevada. It expects to spend $15,000,000 in the next ten years. The power company now owns one-third of the taxable land of Alpine County, Cal.

TEKAMAH, NEB.—The citizens have voted to issue bonds for the construction of an electric light plant.

UNIVERSITY PLACE, NEB.—R. E. Shelley, City Clerk, writes that the contract for constructing an electric light plant has been awarded to Bicker & Lowell, of University Place, for $3,890.

WOOD RIVER, NEB.—D. D. O. Kane, village clerk, writes that the contract will probably be let in about 30 days for the construction of water works and an electric light plant.

LACONIA, N. H.—The Laconia Electric Company has installed a new 750-kw generator, the output from which will be used for lighting circuits.

CAMDEN, N. J.—The Consolidated Lighting Company has filed articles of incorporation with a capital stock of $100,000. The incorporators are William C. Haines, Theodore B. Fryer and Winfield Haldwell.

ELBERON, N. J.—S. J. Ludlow, Jr., and E. S. Hill were appointed receivers of the New Jersey Consolidated Water & Light Company, a corporation recently formed to take over the plant and assets of the Elberon Water & Light Company. It appears that the defendant company is virtually a reorganization of the old Elberon company and supplies a number of seaside places adjacent to Deal.

BROOKLYN, N. Y.—Bids will be received until Sept. 4 at the Bureau of Yards and Docks (R. C. Hollyday), Navy Department, Washington, D. C., for furnishing 15 motor-generator sets and accessories for the Brooklyn Navy Yard as per specification No. 1560. The estimated cost is $72,000.

DUNKIRK, N. Y.—The Buffalo & Lake Erie Traction Company is reported to be considering the construction of a branch line from North East to Findlay Lake.

HARMONY, N. Y.—The Panama Power Company, capital $4,000, has been incorporated by Walter Tanner and others.

LITTLE VALLEY, N. Y.—M. L. Ansell, village clerk, writes that bids will be received on Aug. 30 for improvements to the electric light plant. Probable cost of work, $10,000. G. S. Boller, of Little Valley, is engineer.

NEWARK, N. Y.—The Gas & Electric Development Company, of Philadelphia, Pa., has consummated a sale of the New Light, Heat & Power Company, of Newark, N. Y., to Messrs. Lothrop & Milldram, of Boston, Mass. The new owners expect to make extensions and increase the capacity of the plant.

NEW YORK, N. Y.—C. B. J. Snyder, superintendent school buildings, New York City, has awarded contracts to T. Fred Jackson, Inc., 592 Columbus Avenue, for installing electric equipment in School 66, Manhattan Borough, at $11,785, and School 19, Richmond Borough, $7,120, and to Griffin & Company, 150 Nassau Street, for School 91, Manhattan Borough, $15,394.

SODUS, N. Y.—Materials have arrived for the transmission line which the Sodus Gas & Electric Light Company will soon build to Williamson. The local plant in Williamson will be abandoned as soon as the line is completed.

ROCKY MOUNT, N. C.—Bids will be received until Sept. 1 by W. L. Thorp, Mayor, for $135,000 water, light and street improvement bonds.

TRYON, N. C.—We are informed that the plans for the proposed development of the Tryon Electric Light & Power Company have been changed. A larger plant is now under contemplation, and the probable outlay will be $110,000.

VALLEY CITY, N. D.—Additional machinery, to cost $12,000, has been ordered for the electric light plant.

BERBERTON, OHIO.—The City Council has decided to advertise for bids for lighting the streets. The Northern Ohio Traction & Light Company now has the contract, which will expire soon. Some of the Councilmen are in favor of establishing a municipal plant, but no action has been taken to that end as yet.

BUCYRUS, OHIO.—It is reported that preliminary plans are being prepared for a municipal electric light plant.

COLUMBUS, OHIO.—A. S. Metcalf has filed his report with the Uniform Bureau of Accounting on the electric light plant at Ashtabula. Allowing 7½ per cent depreciation, the net earnings were $2,322.44. The present value of the plant is $71,109.03.

MARION, OHIO.—The Columbus Northern Railway, Power & Equipment Company has amended its charter, giving it authority to operate an electric railway system in connection with its power plant. The company was organized to build and operate the power plant, which serves the Columbus, Delaware & Marion Railway Company, of Columbus.

NELSONVILLE, OHIO.—According to the report of Examiner Leslie Smith, of the State Bureau of Public Accounting, the cost of lighting street lamps here under the municipal plan is $88.14 each. It is shown that the expenditures for the plant some months were much larger than the receipts.

OKLAHOMA CITY, OKLA.—The City Council granted the Oklahoma City Street Railway Company the right to build its $180,000 power house at Bell Isle, which is outside the city limits.

WALTER, OKLA.—The Walter Electric Light & Power Company has been granted a franchise to construct an electric light plant at an estimated cost of $25,000.

BEND, ORE.—The city contemplates purchasing the present electric light plant, and also contemplates installing a gravity water system. H. C. Ellis is the City Recorder.

EUGENE, ORE.—Geo. N. Miller, of Eugene, writes that it is proposed to construct a power plant at Swisshome, to cost between $50,000 and $100,000.

LEBANON, ORE.—N. R. Lang has appropriated 400,000 cubic inches of water from the south fork of the Santiam River. Canals and flumes will be built above Waterloo. The canals will be 10 feet deep and 40 feet wide.

PORTLAND, ORE.—Plans have been practically completed for the erection of a $1,000,000 power plant on the head waters of the Sandy River, a few miles east of this city, to furnish electric power for the United Railways, which is building an interurban line between Portland and Salem.

PORTLAND, ORE.—The Portland General Electric Company, the subsidiary lighting corporation of the Portland Railway, Light & Power Company, has filed plans with the city engineer for a plant costing $200,000 to furnish steam heat to the business section of the city. Many of the largest business houses and office buildings have contracted for heat, and it is expected that the system will be in operation before cold weather sets in.

ALTOONA, PA.—The Citizens' Electric Light, Heat & Power Company is making arrangements to place its wires underground in the central part of the city. The company has recently placed an order for two 800-hp Keeler boilers, which will be installed in about 30 days.

WOONSOCKET, R. I.—A sub-station is being built by the Rhode Island Company in Limerock to furnish electricity for operating the Providence & Burrillville Railway, which is at present supplied by the Woonsocket Electric Machine & Power Company. The contract calls for

the completion of the station by Oct. 1. When completed the building will be equipped with two 500-kw rotary converters.

GARY, S. D.—The Council is reported to be considering the utilization of the water power here for a new lighting system.

RAPID CITY, S. D.—Within another year the Black Hills will have a third power plant. The latest company to enter this field is the Dakota Power Company.

BRISTOL, TENN.—The syndicate that proposes to expend $600,000 in developing the water power of Holston River at Fish Dam for electrical purposes has obtained a 30-year franchise for lighting in Bristol, Va., and will secure a similar franchise in Bristol, Tenn. About 7000 horse-power will be developed.

CHATTANOOGA, TENN.—The Chattanooga Electric Company has been given the contract to put in an electric light plant at the county jail.

KNOXVILLE, TENN.—It is authoratively stated that W. J. Oliver, of Knoxville, will receive the contract to construct the dam and power house on Little Tennessee River for the Knoxville Power Company. The estimated cost is about $2,500,000.

PARK CITY, TENN.—The City Council has passed on second reading an ordinance granting the Knoxville Railway & Light Company, of Knoxville, a franchise to light the streets of the city.

EL PASO, TEX.—The City Council has accepted the recommendation of the Mayor to revoke the franchise of the Southwestern Telegraph & Telephone Company, and the city clerk has been directed to notify the officers of the company at Dallas and the local officers of such action. The officers of the company will have 30 days to answer the allegations.

SEGUIN, TEX.—The Trustees of the electric light and water works system have decided to equip the power plant of both the electric light and water works with steam power. It was voted to issue $5,000 for a boiler and engine to be installed in the electric light plant. K. von Boeckman is manager.

TEMPLE, TEX.—Judge Calhoun, of the District Court of Calhoun County, has appointed E. A. Glass, of San Antonio, as receiver for the Bell Telephone Company, which operates independent telephone exchanges at Temple and Belton.

DAVENPORT, WASH.—The Washington Water Power Company, under the name of the Big Bend Light & Power Company, will invade the Big Bend country and will furnish power and light to the different cities and town of this section. Power will be ready for delivery by Jan. 1, 1908. W. C. Sivyer will be at the head. Surveyors are out laying out the pole line. Capital stock of the company is $300,000.

WASHBURN, WASH.—The Common Council on Aug. 7 passed an ordinance bonding the city for $15,000 to purchase the outside electrical equipment of the Washburn Electric Light & Power Company. The city expects to lease from the lighting company its power plant until such time as the city can construct its own power plant on the Sioux River near here.

WHEELING, W. VA.—It is reported that the owners of the Red Bord Mine near Tiltonsville will soon erect a power plant of its own. The company now secures its power from the Wheeling Traction Company.

ASHLAND, WIS.—The only bid received for the construction of the municipal electric light plant was submitted by W. E. Ule, of Stevens Point, for about $130,000. It is stated that new bids will be called for.

MILWAUKEE, WIS.—R. W. Hunt & Company, engineers, have presented an estimate on the cost of the first work proposed on the municipal electric plant under the specifications they have prepared. The estimated cost of the gas producer plant is $100,000 and of the engines $400,000.

VANCOUVER, B. C.—Hon. A. B. Aylesworth has advised the Department of Marine that there is nothing in the terms of the agreement with the Marconi Company to prevent the Government from erecting wireless stations and equipping them with other instruments. Consequently the Government has proceeded to establish and operate wireless stations on the Pacific Coast.

TORREON, MEX.—The Torreon & Laredo Electric Light Company closed the contract for the purchase of $200,000 worth of new electrical equipment to be installed both in this city and Gomez Palacio.

New Industrial Companies.

THE AMERICAN ENGINE COMPANY, of Bound Brook, N. J., has filed a certificate increasing its capital stock from $250,000 to $350,000.

THE BAKER MOTOR VEHICLE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $20,000. The directors are F. R. White, G. H. Kelly, Cleveland, Ohio, and Nathaniel Platt, of New York, N. Y.

THE BATTERY LIGHT & POWER COMPANY, of Milwaukee, Wis., has been incorporated with a capital stock of $5,000,000. Among the incorporators are Fred D. Underwood, F. G. Rice, A. W. Trenholm and E. H. Johnson. J. W. Wegner, of Milwaukee, is president of the company, and Frank G. Curtis is secretary.

THE SPLITDORF LABORATORY, of New York, N. Y., has been incorporated with a capital stock of $500,000. The directors are: Henry Splitdorf, John Splitdorf and J. M. Fisher, of New York, N. Y. The company will deal in electrical specialties.

Obituary.

MR. EDWIN ROGERS, of Boston, Mass., died at his summer home at York Beach, Me., on Aug. 16. Mr. Rogers is said to have invented the electric push button. He was 65 years old at the time of his death and is survived by a widow and daughter.

MR. L. L. DAVIS.—The death of Mr. L. L. Davis, of Springfield, Mass., occurred on Aug. 13 at Laconia, N. H. He had been ill for two years with a complication of diseases. Mr. Davis, who was about 60 years old, had of late made his home regularly at Laconia, where he had been accustomed to stay a good deal of the time. He was the proprietor of the Davis Level and Tool Company and the Davis Electric Manufacturing Company. He leaves one daughter.

MR. DAVID E. EVANS.—Advices from Baltimore, Md., of Aug. 15, state that Mr. David E. Evans, president of the Maryland Telephone Company, died there on that day of peritonitis. He was prominent as a consulting electrical engineer and as a builder of railways. He was born in Wales fifty-seven years ago. While a young man there he won the praise of Queen Victoria for his heroic rescue of a party of miners cut off below ground by a rush of water. He became connected at a very early date with the old Brush Electric system of Baltimore, under Mr. Frank J. Morrison, and helped in the upbuilding of the modern central station industry.

Personal.

MR. E. M. HERR, vice-president of the Westinghouse Electric & Manufacturing Company, has sailed for Europe.

MR. C. A. COFFIN, president of the General Electric Company, sailed for Europe last week and is not expected to return before the fall.

MR. EDWARD D. ADAMS returned recently from a trip to Europe much benefited by the change, this vacation being the first in some three years.

MR. J. D. GABOURY has resigned as manager of the Gadsden, Alabama City & Attalla Street Railway, of Gadsden, Ala., and also as manager of the lighting and ice plants of the same company.

MR. BION J. ARNOLD has been visiting New York City and, it is rumored, may assist the Public Service Commission in its proposed appraisal of traction properties in Greater New York. He saw members of the Commission while here.

MR. GEO. S. HALEY, who has been superintendent for several years of the Rutland City Electric Company, has been appointed general manager of the Rutland Railway, Light & Power Company, vice David Fox, resigned.

MR. GEORGE A. BROTHERS, of Hookset, N. H., has been appointed manager of the municipal electric light plant at Hudson, Mass., to succeed Mr. J. C. Norcross, who resigned. Mr. Brothers has been connected with the Manchester Traction, Light & Power Company for ten years.

MR. HENRY M. HUXLEY has resigned from the manager's staff of the Worcester District of the American Steel & Wire Company to become assistant general manager of the Duplex Metals Company, manufacturers of the Monnot copper-clad wire and sheets. Mr. Huxley will be located at the New York office, 208 Fifth Avenue.

MR. L. S. MONTGOMERY, who has until recently been at the head of the sign department of the Mobile Electric Company, of Mobile, Ala., and who is well known through his contributions to the National Electric Light Association proceedings, has left the central station business to travel for the Western Electric Company in Alabama.

MR. R. C. SMITH.—Effective Sept. 1, Mr. Richard C. Smith, formerly of the American Steel & Wire Company and the National Wire Corporation, has been appointed sales agent of the Safety Insulated Wire & Cable Company, to take the place of Mr. Avery P. Eckert, resigned. Mr. Smith has appointed as his assistant, Mr. R. C. Wilson.

MR. DAVID FOX, who has been general manager of the Rutland Railway Light & Power Company, of Rutland, Vt., which company controls the Chittenden Power Company, the People's Gas Company and the Rutland City Electric Company has tendered his resignation and will leave Rutland early in September for Mexico, whither business interests have called him.

MR. C. H. MERZ.—U. S. Consul-General John P. Bray, of Melbourne, writes that the government of the State of Victoria, Australia, has engaged the services of Mr. Charles H. Merz, one of the leading English consulting electrical engineers, to report on the suggested electrification of the suburban railways of the city of Melbourne. Mr. Bray states that Mr. Merz will arrive in Melbourne in November.

MR. GEORGE ALFRED DAMON, managing engineer of the Arnold Company, of Chicago, is the subject of an extended biographical sketch by Prof. Mortimer E. Cooley in a recent issue of the *Michigan Technic*, published semi-annually by the University of Michigan Engineering Society. Mr. Damon is justly one of the electrical engineering graduates of the University of Michigan of whom the institution feels proud, and is one whose advice has been sought by many a young graduate.

MR. KEMMANN, city engineer of Berlin and engineer of the Elevated & Underground Railway of that city, and Mr. Paul Wittig, general manager of that company, are on a visit to this country. Their purpose is to investigate the development of subways and underground electric railways here, particularly the latest methods of construction, as their company has some important extensions under contemplation. They are planning to visit New York, Brooklyn, Boston, Philadelphia, Buffalo and Chicago.

MR. F. B. MALTBY, who has been connected with the Panama Canal work as principal assistant engineer to Mr. J. F. Stevens, has resigned to go with Dodge & Day, engineers and constructors, of Philadelphia, in the capacity of chief engineer. He is a graduate of the University of Illinois, class of 1882, and in 1907 received an honorary degree from the same institution. He has had a long experience in railroad construction work, municipal engineering and irrigation work, and been connected at various times with the Wisconsin Central, Missouri Pacific, Great Western and Illinois Central railroads. He had charge for the United States Government of all the dredging operations in the lower Mississippi River, and designed and built the lock and movable dam on the Osage River in Missouri for the Government. He has been connected with the Panama Canal for the last 2½ years, having had charge of the construction work of railroads, docks and wharves, shops and dredging. He constructed a cold storage plant, laundry and bakery in Panama. Mr. Maltby has designed over $1,250,000 worth of dredging plant for the canal work, and the preliminary plans and construction work for the Great Gatum lock and dam were done under his direction.

MR. GEORGE WESTINGHOUSE sailed for Europe last week. The New York *Times* quotes him as follows: "Mr. George Westinghouse, before sailing for Europe last week, spoke optimistically of the business outlook. He said the July business of the companies of which he is the master spirit was the largest on record. The cheerful tone of his talk, coming at a time when nearly every industrial executive is voicing some apprehension of the future, is characteristic of the inventor. He is always an optimist. Last spring, when his company was about to offer new securities to its stockholders at a time when all other industrial concerns were having a hard time to get new capital even by paying a high premium. Mr. Westinghouse scorned to apply to banking interests for underwriting. He was certain that the stockholders of his concern, who have been rewarded with an enormous aggregate of dividends, would not fail to take the utmost advantage of the opportunity to get more stock, regardless of temporary market conditions. The securities were not all taken, but it it safe to say that a larger proportion of stockholders subscribed than would have come in under similar conditions in a less 'personally conducted' enterprise. Mr. Westinghouse carries the same keen enthusiasm into all the affairs of his business. Stockholders of the Westinghouse Electric & Manufacturing Company received last month, in addition to an annual report, a supplementary circular which expressed the president's superabundant feelings on the peculiar fitness of his fellow-administrators of the company."

Business Notes.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, has removed its San Francisco sales offices from the temporary location at 11 Hawthorne Street, San Francisco, to the Crocker Building, that city, where they will be permanently located.

STONE & WEBSTER.—The Stone & Webster Engineering Corporation, constructing engineer, announces that on Aug. 19 it will begin occupation of its own building, 147 Milk Street, Boston, corner of Batterymarch Street.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUG. 13, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

862,871. PROCESS OF REDUCING METALLIC SULFIDS; E. L. Anderson, St. Louis, Mo. App. filed Feb. 23, 1907. In the reduction of sulfid ores, the process of subjecting the ore to the action of an electric current flowing from an insoluble anode to the ore serving as a cathode, in an electrolyte capable of dissolving the metal constituents of the ore when freed of its sulphur, then reversing the current whereby the salt solution thus formed is decomposed and the metal becomes deposited on the resulting cathode, substantially as set forth.

862,891. TROLLEY POLE SUPPORT; H. W. Fellows, et al., Hollywood, Cal. App. filed April 13, 1906. Has a link support for the trolley pole. One of the link members is very heavy so as to move slowly, and in case of rapid upward movement of the pole its slow movement causes its disengagement.

862,916. ELECTRICITY MOTOR METER; G. Hookham, Birmingham, Eng. App. filed Nov. 6, 1906. Foucault brake meter having a single powerful magnet with a pair of poles, one on each side of the armature disk and provided with means for reducing fluid friction and for preventing the passage of current through the metal of the poles.

862,934. TROLLEY CATCHER AND RETRIEVER; J. L. Perkins, Springfield, Mass. App. filed Feb. 21, 1906. A trolley retriever of the type having a spring reel which is normally restrained against winding movement by a latch or detent.

862,935. APPARATUS FOR WINDING INDUCTION COILS; C. A. Pfanstiehl, Highland Park, Ill. App. filed Dec. 27, 1906. Has a holding reel carrying the supply coils and a winding head having a series of coil unit spools and adapted to simultaneously wind therein individual unit windings, the wire being drawn through a parrafine bath.

862,938. METHOD OF MAKING COMPLETE FUSE STRIPS OF SAFETY FUSES; F. D. Reynolds, Hartford, Conn. App. filed June 16, 1906. The method of making safety fuses which consists in clamping the terminal wires to be joined to the fuse wire, wrapping the ends of the fuse wire, and then soldering the wrapped ends.

862,951. BRUSH-HOLDER; W. L. Waters, Milwaukee, Wis. App. filed Dec. 5, 1904. A commutator brush having a rock arm grooved to guide the brush in a longitudinal movement toward and from the commutator, the brush having a permanent flexible connection to permit such movement.

862,974. SAFETY DEVICE FOR THE IGNITION OF SLOW MATCHES; Franz Kammler, Gelsenkirchen, Germany. App. filed March 9, 1907. Relates to a safety device for the ignition of slow matches and other explosives which is particularly adapted for use in mines or pits. Covers detail features of construction.

862,996. PROCESS OF REDUCING COMPOUNDS AND PRODUCING LOW-CARBON FERRO ALLOYS; E. E. Price, Niagara Falls, N. Y. App. filed Nov. 14, 1905. The process of reducing refractory compounds, which consists in percolating a molten reducing agent essentially comprising a highly oxidizable element, through a granular body of the compound, as set forth.

863,008. ELECTRICAL MEASURING INSTRUMENT; W. E. Sumpner, Birmingham, Eng. App. filed Oct. 19, 1905. Relates to instruments of the dynamometer class intended for use on alternating current circuits. Provides means whereby iron may be used in the construction without giving rise to errors from variable permeability, hysteresis, etc.

863,044. METHOD OF CHARGING ELECTRIC FURNACES FOR PRODUCING CARBID FROM LIME AND CARBON; A. J. Peterson, Alby, Sweden. App. filed Oct. 30, 1906. The process of producing carbid which comprises introducing carbid forming base and carbon in separate contacting columns into an electric furnace, passing an electric current through the column of carbon to heat the same to reacting temperature at the surface of contact between the two columns.

863,109. INDICATOR FOR ELECTRICAL MEASURING INSTRUMENTS; F. G. Simpson, et al., Seattle, Wash. App. filed April 29, 1904. Relates to indicators which may be installed with or attached to instruments for measuring direct pulsating or alternating currents, and aims to prevent tapping of the circuits by maliciously disposed persons, and also the detection of grounds and defective insulation.

863,148. RAILWAY SIGNAL; W. W. Brown, Schenectady, N. Y. App. filed Feb. 14, 1906. Mechanical features of construction of an arrangement whereby a single operating means may be employed to move a home and distant semaphore signal successively.

863,152. HOIST; J. H. Clark, Schenectady, N. Y. App. filed March 10, 1904. Has an electrical hoisting motor and current supplying means of smaller capacity than said motor, whereby said motor may be installed without injury to the system.

863,163. PROTECTIVE DEVICE FOR SERIES TRANSFORMERS; C. E. Eveleth, Schenectady, N. Y. App. filed Nov. 12, 1904. Has means for automatically short-circuiting some of the turns of a transformer winding when the e. m. f. exceeds a certain amount.

863,165. CIRCUIT CONTROL APPARATUS; R. Fleming, Lynn, Mass. App. filed Dec. 5, 1905. Has a pair of flexibly supported normally stationary contact members, a floating contact between said normally stationary contacts, and electro-magnetic means for moving said normally stationary members toward each other whenever the floating contact engages either of them.

863,175. INDUCTION COIL; J. O. Heinze, Jr., Lowell, Mass. App. filed March 18, 1907. Pancake construction of induction coil having the partitions between the pancakes slotted to receive connecting wires.

863,177. AUTOMATIC TRIPPING SAFETY DEVICE FOR ELECTRIC MOTORS; A. Herath, Schenectady, N. Y. App. filed Aug. 7, 1905. Provides a device for swinging by supporting the motor upon the driving axle, whereby the motor may be thrown out of gear when the motor is disconnected for any reason.

863,185. PROTECTIVE DEVICE FOR ELECTRIC CIRCUITS; T. I. Jeffries, Pittsfield, Mass. App. filed Nov. 22, 1904. Has a single coil so arranged that it controls two movable members, one opened with a time-limit device and the other without. Thus a single coil takes the place of the two coils which have sometimes been employed before.

863,188. MOTOR CONTROL; C. B. Larzelere, Schenectady, N. Y. App. filed Jan. 16, 1907. The method of changing a pair of series motors from series to parallel which consists in connecting halves of each field in parallel and then disconnecting a half field of each motor, and employing these half fields to connect the motors directly to the current source without opening the circuit. Is especially adapted for electric automobiles in which two motors are used for driving the rear wheels and which it is important not to unbalance in use.

863,201. MEANS FOR PROTECTING DYNAMO ELECTRIC MACHINES; C. T. Mosman, Schenectady, N. Y. App. filed Feb. 6, 1903. Has means for short-circuiting the armature of the booster and preventing the generation of current when it is short-circuited.

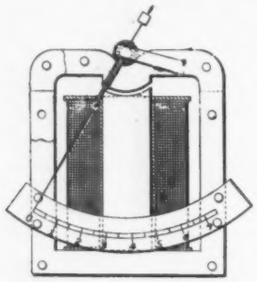
863,207. FIELD COIL TERMINAL CONNECTION; E. W. Olds, Milwaukee, Wis. App. filed Oct. 18, 1905. Has means for guiding the terminals of a field coil through the casing of a motor so as to be water tight in use.

863,224. ELECTRIC METER; G. A. Sawin, Swampscott, Mass. App. filed Jan. 8, 1907. The meter casing is so arranged that convenient access may be had both to the front and the back of the meter, or either, with the use of a minimum number of sealing pins.

863,230. TELEPHONE REPEATER CIRCUIT; H. E. Shreeve, Newton, Mass. App. filed May 4, 1906. A telephone current reinforcing system comprising a main telephone circuit connecting terminal station telephone apparatus, a reinforcing circuit, and a balancing circuit, the said main, reinforcing and balancing circuits being all in inductive relation only with one another.

863,237. MACHINE FOR CONTROLLING POWER OPERATED APPARATUS CONNECTED WITH RAILWAY SWITCHES AND SIGNALS; J. D. Taylor, Wilkinsburg, Pa. App. filed Oct. 26, 1905. Relates to machines for controlling power operated apparatus connected with railway switches or signals. Covers means for automatically moving a lever to final position after electrical locks have been actuated to release the levers.

863,238. INDICATION APPARATUS FOR SWITCH AND LOCK MOVEMENTS; Louis H. Thullen, Edgewood Park, Pa. App. filed March 30, 1906. Relates to indication apparatus used in interlocking railway systems using alternating currents, and provides means where-



863,008.—Electrical Measuring Instrument.

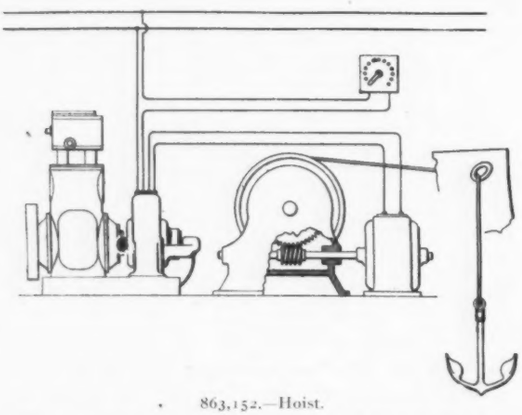
by the operation of the indicator is only effected by an alternating current of predetermined frequency.

863,247. METHOD OF AND APPARATUS FOR TRANSMITTING ELECTRICAL ENERGY; W. C. Yeatman, Chicago, Ill. App. filed Feb. 7, 1903. The method of transmitting electrical energy which consists in impressing an alternating high frequency potential upon a conductor consisting of a central core of high conductivity directly surrounded by a thin and longitudinally continuous sheath of magnetic material, substantially as described.

863,252. ELECTRIC SIGNALING DEVICE; John A. Baker, Galveston, Tex. App. filed Nov. 30, 1906. Electric signaling apparatus by which the lowering of a shelf containing a writing pad effects the transmission of the signal used by watchmen, etc.

863,253. TELEPHONE RECEIVER; W. R. Bankhead, Bremerton, Wash. App. filed Nov. 17, 1906. Bipolar telephone receiver having a diaphragm form one pole.

863,263. RAILWAY SIGNAL MECHANISM; John P. Coleman, Edgewood, Pa. App. filed March 13, 1907. Semaphore signal apparatus



863,152.—Hoist.

making use of liquid carbonic acid gas and having electrically controlled valves by which the gas is admitted to the operating cylinders.

863,268. TREATMENT OF ALBUMINOUS SUBSTANCES; R. Desgeorge, Lyon, France. App. filed Nov. 2, 1906. Process for the treatment of albuminous substances consisting in diluting same with a solution of chlorid of sodium and submitting the product to an electrolytic treatment with the use of metallic electrodes.

863,293. ELECTRIC RESISTANCE DEVICE; H. W. Leonard, Bronxville, N. Y. App. filed March 21, 1905. The combination of a relative conductor, and an infusible composition embedding the conductor, said composition containing fluorin and containing only insoluble materials as essential ingredients when applied to the conductor.

863,296. ELECTROMAGNET; David L. Lindquist, Yonkers, N. Y. App. filed May 9, 1905. An alternating current magnet in which the armature is prevented from moving into contact with the pole by a spring abutment.

863,320. MEANS FOR SECURING AN ELECTRIC LAMP RECEPTACLE TO A SUPPORT; Robert P. Schriver, Philadelphia, Pa. App. filed April 19, 1907. The porcelain of the receptacle is flanged and a metallic band surrounds said flange and is soldered to a supporting surface.

863,322. ELECTROMAGNETIC SOUNDING APPARATUS; William F. Seidel and Ernesto Sassenhoff, Elkhart, Ind. App. filed Sept. 1, 1906. Patentee has a horn or whistle through which air is impelled by a diaphragm. Is vibrated at the required sound period by an electromagnet.

863,332. ELECTROMAGNETIC APPARATUS FOR RAILWAY PURPOSES; Louis H. Thullen, Edgewood Park, Pa. App. filed March 24, 1906. Relates to electromagnetic apparatus comprising electromagnets and co-acting armatures constructed to be operable at small or medium potential and adapted to control the circuits through which heavy currents flow.

863,334. ELECTRIC INSTALLATION PIPE CAP; Wheeler H. Vibber, New London, Conn. App. filed May 3, 1907. A pipe cap having two half cones adapted to be clamped upon the upper end of a pipe, and means for covering the joints between the two half cones.

863,335. SLOW-SPEED CIRCUIT CONTROLLER; Herbert A. Wallace, New York, N. Y. App. filed Dec. 13, 1906. Circuit controller of the type in which the circuit cannot be closed after once being opened until the movement of a mechanism through a predetermined range. Has a drum which it is necessary to rotate through a complete rotation to move the switch lever.

863,338. TELEPHONE TRUNK CIRCUIT; C. S. Winston, Chicago, Ill. App. filed Jan. 3, 1905. In a telephone system, the combination with a telephone line terminating at its central office in a three-point jack, of a telephone line having a central source of current for the actuation of incoming signals terminating at its central office in a two-point jack, means to connect said lines for conversation, and means to supervise said connections, substantially as described.

863,339. ELECTRIC SELF-WINDING CLOCK; Aloys Wirsching, Brooklyn, N. Y. App. filed Nov. 28, 1905. Has a rotatable shaft and means for rotating the same in one direction and means for transmitting the motion to time mechanism.

863,410. DYNAMO CONSTRUCTION; Henry Leitner, Maybury, Woking, England. App. filed June 17, 1905. A regulating system for dynamos driven by the wheel axles of a train to produce uniform voltage under varying speed conditions.

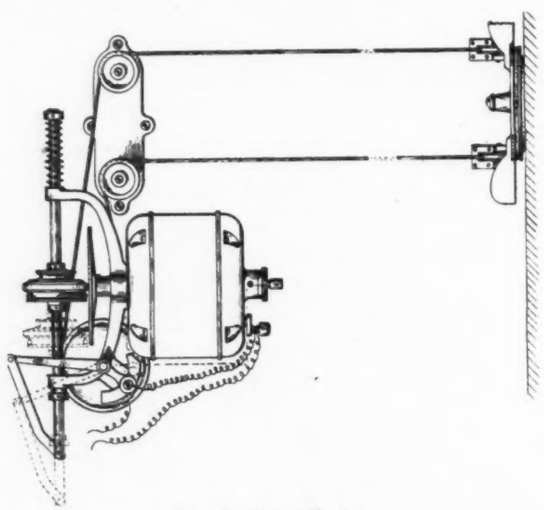
863,418. RAILWAY SIGNAL; Nicola Mucci and Alfonso Celenza, New York, N. Y. App. filed March 23, 1907. Railway signal apparatus by which trainmen are notified in case error has been made by a train improperly taking a side track. Has special trolleys or conductors adjacent the track rails which are engaged by brushes depending from the locomotive.

863,419. CIGAR LIGHTER; Thomas B. Murray, Newport News, Va. App. filed April 24, 1906. A vertical standard carries a wick and supports a tilting lever having a brush which moves adjacent the wick and which also carries a cover to normally prevent evaporation.

863,454. ELECTRIC HEARING ELEMENT; George J. Schneider, Detroit, Mich. App. filed July 9, 1906. Resistance element stamped of sheet metal to produce a zigzag path for the current flow and having openings for clamping rods, the openings of adjacent plates being out of alignment to prevent short circuiting.

863,455. ELECTRIC SAD IRON; George J. Schneider, Detroit, Mich. App. filed July 9, 1906. Electric heater comprising a body having an open recess, a heating element insertable in the recess, and resilient means for electrically coupling said element automatically upon its insertion.

863,478. DENTAL ENGINE; Wallace W. Williamson, Syracuse, N. Y. App. filed Jan. 7, 1907. Dental motor having a flat disk constituting



863,478.—Dental Engine.

a frictional gear and engaged by a small roller movable transversely across its face.

863,509. ELECTRIC RAILWAY SIGNALING SYSTEM; Charles M. Cleavland, Wausau, Wis. App. filed April 8, 1907. Railroad signal having special trolley wires or conductors laid between the track rails, and means for completing circuits to the trains for automatically operating the train controller.

863,531. RAIL BOND; M. Hawkins, Gypsy, W. Va. App. filed Nov. 7, 1906. Provides a U-shaped rail bond, the ends of which are received in holes in the web of the rail and which are grooved to receive pyramidal drift pins with "opposite cutting edges."

863,569. SIGNAL MECHANISM; E. E. Flora, Chicago, Ill. App. filed June 18, 1906. Details of construction of an apparatus for exploding a torpedo in the path of a train when a switch is open. An electrical circuit positions a depressable plate in the path of the wheel flange, so that it is operative to detonate a torpedo.

863,568. ELECTRIC-ARC LAMP; R. T. Felsch, Boston, Mass. App. filed Feb. 21, 1907. Provides a solenoid in series with the lamp circuit having a split core whose opposite members are capable of moving outwardly and upwardly upon increase of current strength in the coil.

863,540. TRAIN CONTROLLING APPARATUS; J. L. Jones, Kizer, Tenn. App. filed Dec. 10, 1906. A wireless system by which trains approaching within a danger limit may be warned, or when trains continue to travel after receiving one or more warnings, the brakes or controlling mechanism will be actuated to stop both trains.